SANITATION

IN THE

BRITISH MERCANTILE MARINE

WILLIAM G. ROMERIL

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BEING

A BRIEF OUTLINE OF THE MORE NOTICEABLE FEATURES MET WITH IN CONNECTION WITH SANITARY MATTERS ON BOARD TRADING VESSELS.

FOR THE INFORMATION OF SHIPOWNERS, SHIPS' OFFICERS, SUPERINTENDENTS, AND BUILDERS, PORT SANITARY INSPECTORS, AND OTHERS.

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WITH NUMEROUS ILLUSTRATIONS.

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That it is the duty of society generally to interfere, through the State, to extend to seamen the same degree of care as is bestowed on so many classes of our fellow subjects. I say society, instead of Government, because no Government can well move in the matter until public opinion requires it. Society means the individuals comprising it; therefore it is on you, who read these lines, that this great, this life-giving duty now devolves.—"Our Seamen," by SAMUEL PLIMSOLL, M.P.

I have found from my own experience, and from what I have heard from others, that plain matters of fact in relation to customs and habits of life new to us, and descriptions of life under new aspects, act upon the inexperienced through the imagination, so that we are hardly aware of our want of technical knowledge.—"Two Years before the Mast," by R. H. DANA, Junr.

PREFACE.

THE subject which I have undertaken to lay before the reader, is the outcome of my experience both at sea and in port sanitary work, and is prompted solely by the opinion that sanitary reform is urgently needed in the British Mercantile Marine.

A great deal has been done by the Board of Trade in ameliorating the conditions under which the seamen labour on board ship; but, unfortunately, the Board is not a Sanitary Authority in the true sense of the term; and, further, they are hampered in their efforts by the laws affecting tonnage.

Chapters I. to VIII. have already appeared in the "Journal of the Sanitary Institute," and also in an abridged form in the "Shipping World."

Owing to the incomplete method of recording deaths of seamen generally, I have not, as I anticipated, been able to compile a correct statement bearing on the death-rate, which would, it is needless to say, have considerably enhanced the value of the chapters on Inquiry into the Deaths of Seamen at Sea.

I must beg the reader's kind indulgence for the many natural shortcomings in this little work, and would ask that the matter be considered simply from a practical and not a literary point of view. And I trust that this effort, though a feeble one, to draw attention to some of the unhealthy surroundings of a sailor's calling, may not be without its effect. It may to many ears sound strange, and inconsistent with tradition, to suggest that a seaman's life is otherwise than a healthy one, but though there are many who survive for years the perils of the sea, and the dangers from within, yet they

must undoubtedly be considered as illustrating the survival of the fittest, and not as owing their halesome longevity solely to their breezy calling. It is in the interest of their physically weaker brethren that I have ventured to place my opinions and experience before the reader.

My sincerest thanks are due to Lieutenant A. G. Froud, R.N.R., Secretary of the Shipmasters' Society in London, and the Reverend T. G. G. Asplet, of St. Helier's, Jersey, for the courtesy and kindly interest extended to me in prosecuting my enquiries, and to Mr. W. J. Albrow, of Greenwich, for his assistance in revising the proofs.

My thanks are also due to Mr. Champion Jones, of Highgate, and Mr. John Ketch, of Rotherhithe, for the use of drawings for Figs. 14 and 15, and Figs. 1 and 2 respectively.

W. G. R.

Greenwich, *November*, 1897.

SANITATION IN THE MERCANTILE MARINE.

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INTRODUCTION.

There are perhaps few people except those immediately concerned who have any practical knowledge of the question which forms the subject of the following chapters, namely, the amount of sanitation or otherwise which obtains in the ships of the Mercantile Marine of the United Kingdom. It is a subject that deserves attention, as it affects a class of men whose hardships and privations we daily read about, and the death-rate amongst whom compares somewhat unfavourably with that of other dangerous callings.

"A ship on the open sea has the solitary advantage of being surrounded by air free from terrestrial emanations. In all other respects it is placed under unfavourable circumstances, for it combines the drawbacks of inadequate crew space, of ventilation liable to frequent interruption, of a moist atmosphere acting on vegetable matters subject to decomposition. A ship in harbour, though in other respects better circumstanced, is often exposed to the most deleterious emanations from low swampy lands and rich alluvial soils. A seafaring life, moreover, is exposed to great and continuous fatigues under circumstances otherwise unfavourable to health, and to a certain extent, and often for long periods of time, to the evils of a monotonous existence. Hence the health of seamen and passengers by sea can only be preserved by the most watchful care and attention to the cleanliness, dryness and ventilation of the ship, the supply of fresh water, and of sound provisions embracing all the elements of a wholesome diet, with suitable clothes, and proper change of clothing, with fitting exercise, occupation and recreation, and facilities for separating the sick from the healthy. The precise means to be adopted to ensure these ends can only be fitly described by those who add to a general knowledge of the principles of hygiene a special acquaintance with the construction and internal economy of ships."*

* Hooper's Physicians' Vade Mecum, Dr. Guy and Dr. Harley.

The majority of shipowners are doing their best to make life comfortable on board ship, as was shewn at the Sanitary Congress held at Liverpool, in September, 1894. But competition in shipping reduces the profits and causes owners to look askance at any expenditure that can in any way be avoided.

The influence of shipmasters and chief engineers with their employers might do much to mitigate many evils, but it must be borne in mind that these officers are at the best in the position of servants, and it is more to their interest to protect their employers from additional expense. Were they to exhibit too great a concern for the "comfort" of their subordinates they might probably be called upon to transfer their kindhearted suggestions and services elsewhere.

It would be instructive to many shipowners to voyage to the East, *viâ* Suez Canal in a modern "tramp" steamer, at any time of the year, and to notice whether surfaces of bare-iron in living spaces and berths situated too near the engine room and stokeholds, are arrangements conducive to health, taking as a basis for their observations the fact that a vessel must be considered both as a dwelling and as a workshop; noting also how awnings are often conspicuous by their absence, and marking the conditions under which the firemen work in the stokehold, and the trimmers in the bunkers.

Crew quarters can and ought to be in such a position on a vessel as to render them habitable under ordinary conditions, and until that is done the main object from a hygienic point of view is not attained. With vessels built of all shapes and sizes, the necessity for increased sanitary supervision when in the hands of the builders is absolutely indispensable. The structural alterations ordered by Port Sanitary Authorities after the vessel leaves the builders, are frequently indirectly the fault of the Administration. Moreover, no distinction is made between vessels trading in the cool latitudes of the Atlantic, or those trading under the melting rays of a tropical sun. Again, a point frequently overlooked is this, that it costs no more in the first place to provide accommodation for crews in accordance with sanitary laws, than to follow a contrary course.

Lower forecastles are still too much *en evidence*, and in this respect

the Scandinavians, Germans, and Dutch, are a long way ahead of the British by locating their crews above deck.

Cubic space.—Authorities on marine hygiene agree that the minimum space of 72 cubic feet for each man, as allowed by the Merchant Shipping Act, 1894, is not sufficient by about one-half. The shipowner is beginning to realize that fact, and in vessels outside of the passenger trade, a decided improvement in this direction is noticeable.

Bilges have been regarded from the earliest time as a region from whence nothing but noxious and noisome products could emanate. The condition of bilges is not now vastly improved, and the day is probably far distant when for its purity, bilge water will be recommended as a beverage.

Ventilation and sanitation generally, especially of engine rooms, stokeholds, and bunkers, needs more care and attention than it has hitherto received. The too frequent cases of "heat-frenzy," and heart-failures, demand it.

Drinking water should be under keener supervision by Port Authorities to ensure that the supply and storage is of a wholesome nature.

Inquiry into the deaths of Seamen at sea is open to much improvement, particularly in cases of "Suicide," or "Supposed Suicide," or those described as "Missing."

CHAPTER I.

FORECASTLES.

Lower forecastles, whether in wooden or iron vessels, have so many disadvantages as crew quarters, that it will be as well to deal with these in detail, and show by diagrams how the principles of the Merchant Shipping Act, 1867, with reference to crew spaces are frequently disregarded. Had the spirit of the Act been strictly carried out such quarters for the crew would now be swept away. The new Merchant Shipping Act, 1894, in this respect differs in no way from the former Act, for the sixth schedule to this Act provides that all crew spaces shall be:—

Securely constructed;
Properly lighted;
Properly ventilated;
Properly protected from weather and sea;
As far as practicable properly shut off and protected from effluvium which may be caused by cargo or bilge water.

Security of Construction.

In all vessels this provision is for obvious reasons strictly complied with; so far as lower forecastles are concerned no question can be raised on this point.

Lighting.

In wooden vessels the common method of lighting these quarters is by means of glass prisms, let into the deck above, termed deck-lights. But the facility and frequency with which these are broken or damaged by chain cables and other ship's gear, points to a great difficulty in securing proper lighting by this means. Moreover the parts of the deck, which would be, under other circumstances, best adapted to such a purpose are, as a rule, in the shade and therefore unsuitable.

Another common method of lighting is by side ports, but with these the rays of light, having a lateral direction only, are obstructed by bunks, &c. With vessels which have a top gallant forecastle deck, this would be the only means available. The scuttle or companion hatch cannot be depended on, as in a head sea or bad weather it

would be closed. The same drawback exists in iron vessels with the addition that the deck overhead is of iron, which results in the side ports being relied upon for the purpose of lighting.

Ventilation.

Fig. 1 illustrates the method of ventilating these places. It will be seen that the ventilator, usually a 4-in. one, is situated between the scuttle-hatch and the windlass. Many vessels, however, in addition to this, have a mushroom ventilator at the fore-end under the bowsprit. The position of both being open to much objection, owing to their proximity to the scuttle-hatch and hawse-pipes respectively.

Protection from Weather and Sea.

A leaky deck is a common source of great discomfort and is mainly due to the working and straining of windlass, bitts, and the dragging of cables over the deck, but, beyond this, lower forecastles may be considered sufficiently protected from weather and sea.

Effluvium from Cargo and Bilge.

From a hygienic point of view this provision remains to the present day, practically a dead letter, the words "*as far as practicable*" are taken in a liberal spirit, and it would be difficult to find a lower forecastle without effluvium from cargo or bilges. This is mainly in consequence of defective bulkheads, insufficiently caulked linings and forecastle floors, and to render these tight is next to impossible. From the constant straining of the vessel, the hull of a ship is continually on the work. This will be worse when plunging in a heavy head sea, at which time the labouring and straining will probably be severe. When lying becalmed, heavy rolling will have more or less the same effect. In port it will occur from the distribution of cargo in holds and grounding on uneven bottoms.

In iron vessels a considerable difference is found in the construction. The divisional bulkhead, or as it is commonly termed the collision bulkhead, is of iron, and is generally tight. The space between frames abreast of deck stringers is cemented, so cutting off the bilge in this direction, yet this is liable to become defective and is seldom renewed.

Another source of trouble which does not add to the salubrity of the place, is the ship's and boatswain's stores, kept in lockers or in some cases even under the bunks.

Allusion has already been made to the leaky deck caused by the working of the windlass.

With regard to cubic space, the amount found in most of these vessels comes well within the provision of the Merchant Shipping Act.

Fig. 1 will show what is common to most lower forecastles. The hidden bilge (*a*) (*a*) (*a*) is probably the worst feature to deal with. The difficulty with this is that it cannot be thoroughly cleansed. The older the vessel, the more liable will this be to pollution from impurities due to decay and other causes. (*b*) is the coal locker below the forecastle floor, access to which is usually by an ill-fitting hatch. The floor (*e*) from constant traffic is never properly tight, and any water spilt or used for cleansing purposes finds its way into the coal and chain lockers (*c*). There is always a certain amount of mud adhering to the cable which increases the nuisance. The consequence is that immediately below the floor, we have a damp mass giving off a most unpleasant smell. The foul air arising from the bilges finds its way between the frames and through the uncaulked and defective lining (marked by arrows in Fig. 2), which may have been caulked when the vessel was new, but is seldom renewed afterwards. Taking into consideration the fact that bunks, where men have to sleep, and food lockers, where the daily and weekly provisions are stored, are built up against this lining, it can well be imagined that the existence of human beings in these stuffy and malodorous places is not to be envied.

Fig. 3 represents a lower forecastle common to small steam vessels in the coasting trade. The top gallant forecastle deck renders it difficult to ensure proper lighting, the side scuttles are the only means available, a method open to many objections as the rays of light are obstructed by bunks, &c.; the floor in all cases being in the dark, a point of no little importance where cleanliness is concerned. Below the floor is the forepeak wherein will be stowed cargo gear, ship's stores, old disused ropes, &c. The chain locker at the after end of the peak presents the same nuisance as in Fig. 1, access to both these places is in most cases from the forecastle by an ill-fitting hatch. At each side on the after end is a pipe (untrapped) leading direct to the bilge.

The law affecting the question of tonnage proves rather a stumbling block to sanitation, because in fulfilling the requirements laid down by the Merchant Shipping Act, lower forecastles may be deducted from the register tonnage, a fact which the shipowner is not slow to recognise, as it is upon the registered tonnage that port dues, &c., are calculated. Yet it is to be hoped that when the insanitary condition of these places is fully appreciated by owners, they will take it upon themselves to erect quarters on deck, thus conferring a boon upon those whose calling is, at the best of times, without many of the comforts of existence.

Scandinavians, Dutch and Germans are a long way ahead of the British Mercantile Marine in this respect, as we find few such places in their vessels. It is said that this is due to their timber trade. The bow port is used in shipping the timber, which thus passes through the space where the lower forecastle would be situated. This may be, but from the author's experience the crew quarters on these vessels have no fault in common with lower forecastles.

Upper or Topgallant Forecastles.

Owing to their position above the main deck, and freedom from sources of pollution common to lower forecastles, possess many advantages as crew spaces.

The improvement effected of late in these forecastles, augurs well for the future of seamen. Still there is much to be done. The windlass, which at one time was an encumbrance, together with its accompanying hawsepipe nuisance,* is slowly giving way to improved mechanical arrangements. Situated as these quarters are in the bows, where in bad weather or plunging into a head sea, the conditions are worse than in any other part of the vessel, the need of efficient and continuous ventilation is most desirable. Lighting is as a rule not properly regulated, too much dependence being placed in side ports and decklights. The seaman's *bête-noir* is the fore-peak hatchway, which is situated in the forecastle. The daily traffic to and from this place causes endless annoyance and friction between officers and men. The position of food lockers too requires more consideration, as they are frequently found built up against the partition of paint and lamp lockers, and in some instances against that of a closet. Paint and lamp lockers should never adjoin living rooms, unless separated therefrom by an iron bulkhead. In warm climates, iron decks, when exposed to the direct action of the sun's

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* Captain D. Wilson Barker, R.N.R., in a letter read before the members of The London Shipmasters' Society at the Fishmonger's Hall, cites the following amusing description of the top gallant forecastle of a ship bound down Channel in winter. "If fortunate enough to have secured an upper bunk you could recline at ease, watch the sea rushing through the hawseholes at every dive the ship made, and by the light of a glorious slush lamp see your chest and those of your shipmates ride on the crest of a wave to their own destruction and your discomfort. When at eight bells you are turned out of your nest, your mate of the tier below took your place, you found yourself in the lee scuppers, sprawling in the midst of water, soaked bread, empty beef kids, bottom boards of the lower bunks, clothing, and sundry other articles, whilst the good old ship plunged and dived, adding water to water, till the sea ran boldly out of the lee doorway, &c." This condition of things is not common now-a-days, but it does happen occasionally.

rays, become exceedingly hot, the heat by conduction increases the temperature in crew spaces and adds to the discomfort of the men.

Before dealing with the arrangements in detail, it will be necessary to point out that the internal fittings of forecastles do not usually form part of the main structure of a vessel, thus making it easier to obtain the desired reform. We have merely to deal, so to say, with an empty space where fore and aft bulkheads, paint and lamp locker, boatswain's and donkeyman's berths and food lockers, *vide* Fig. 4, as a rule are left to the discretion of the builders, who in this, as in other important sanitary matters, are allowed too much latitude.

Bunks or sleeping berths are capable of much improvement, being in nine cases out of ten overwooded, and built up in most inconceiveable places regardless of shape and dimensions.

The Board of Trade instructions to Surveyors provide that, "If a privy adjoins a crew space the bulkhead should be doubled with felt between the doubling and the bulkhead."

Again, on the drainage of the forecastle "Where such drainage passes through a privy or other compartment, it will be necessary to have a pipe for the drainage to pass through such privy or compartment, with the pipe made perfectly tight through the cant or coaming of the forecastle." These are serious matters unfortunately too often overlooked at the time of building.

Greater attention should also be paid to the joint of the bulkhead at the vessel's side, which, if not properly made, will be another means of communication and one not to be ignored.

"Sweat-boards" close up to the deck are to be commended for the purpose of insulating iron over bunks, as they are easily removed for cleansing and painting, and are easily replaced, care being taken that they be of sufficient width to overlap the bunk on either side.

Sailors' quarters should in all cases be fitted with a large oilskin locker as near to doorway as possible.

Firemen and deckhands, owing in a measure to the different nature of their work, should never be located together. The unnecessary squabbling amongst them, with reference to the cleansing of the forecastle, and the neglect which follows, condemns a practice, which, however, may be said to be restricted to small vessels. A divisional bulkhead in most cases is the only remedy and it is inexpensive.

In large sailing vessels, it is always well to have the forecastle divided, one side for the port and the other for the starboard watch.

Deck Houses.

"Now comes the question to what degree of health man may hope to attain, having regard to existing circumstances and customs, and without heavy expenditure, in other words, without building castles in the air, or seeking to inhabit balloons, as he would require to

do to become as healthy as the birds. This condition is therefore unattainable; and here as everywhere, to demand perfection leads to realizing little or nothing.*"

Yet perfection should always be the direction aimed at by human efforts, however imperfect may be the result; and the success of Sanitary legislation will be measured by the nearness or the distance of its actual results from the perfect idea. This is the spirit in which the Public Health Acts of this country have been enacted from time to time for the good of the people and the country generally. To Sanitary Scientists much is due for their untiring energy in this direction, but however much they have advanced the science of how to live healthily, their efforts in the main have been devoted to the laws which govern the elements on shore; and although the same natural laws will apply to vessels afloat, still the construction of a ship differs so much from that of a house, that to obtain a like degree of success, a greater attention to this subject is needed.

Now the point is, what is *l'objet désiré* in crews' quarters. The upper or top-gallant forecastle is a decided improvement on the lower forecastle, still it leaves much to be desired. In steamers, the alleyways do not offer sufficient facilities for maintaining a habitable condition under all circumstances. But with deck houses the case is different. Situated above the main deck, constructed as a rule mainly of wood, with good ventilation and proper lighting made easy, they afford conditions which should be taken greater advantage of. Deck houses possess even greater facilities for ventilation than houses on shore, and this is one of the principal objects aimed at.

The following deck house illustrations are for the purpose of showing how the insanitary lower forecastle difficulty may be overcome.

Figs. 5 and 6 represent the plan and section of the crew arrangements on a German schooner of about 150 tons employed in the coasting trade. This method of location is also common to Dutch vessels. On all the important rivers of Germany and Holland this custom prevails.

The after cabin below deck is exclusively the master's. The mate and boatswain are located in the after part of the deck house, which place is likewise fitted as a mess room, where, together with the master, they take their meals. On the forepart adjoining this place will be found the sailors' quarters and galley. The bunks, it will be seen, run athwartships as well as fore and aft, and are conspicuous by their box-like shape against the divisional bulkhead and side of the house. Access to each bunk is by a narrow entrance fitted with a slide. This is the one great fault which attaches to these

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* Dr. Jaeger on "Health Culture."

sleeping berths, because in the winter months the men will close these apertures; and if it were not for the defective lining and ill-fitting bottom boards, the consequences would probably more often be fatal.

The disadvantage of having the galley so near the crew spaces is that, in addition to the heat it generates, it attracts all sorts of insect life, and assists in a great measure to foster vermin so prevalent in places where there is much wood lining.

Having a raised deck aft above the master's cabin, enables the officers on watch and the helmsman to have a clear view of the ship's head and the forepart of the vessel.

Light and ventilation is by skylights and side ports.

Figs. 7 and 8 are section and plan of the crew arrangements on a Dutch sailing barge employed in the coasting trade, which may be called a family ship, and is typical of the many of this class found on all the large rivers of the Continent. For comfort and cleanliness, it must be admitted they surpass anything to be seen afloat. Every available space is chosen to advantage, and "a place for everything, and everything in its place," appears to be the order of the day.

The deck cabin has a skylight and four square ports at the sides, which are protected in bad weather by iron shutters. Cupboards and food lockers come in for particular care; in the case of the latter they are not to be found in living spaces. The good "frau" has no need to go on deck for water, as by a very suitable and simple contrivance she can either pump the water from over the side or from the fresh-water tank. The sleeping berth is also well lighted and ventilated.

The sail lockers between the cabin and sailors' quarters form a good division.

In Scandinavian vessels all crew spaces are above the main deck; the master's and mates' being located in a separate deck house to that of the sailors; both places being well lighted and ventilated. But the bunks are found to be in all cases extravagantly wooded, and the lower bunks raised but a few inches from the floor.

As to the design and internal fittings of deck houses in general, a great deal will depend on position and space. When convenient, bunks should have iron frames, and as little wood about them as possible. Food and oilskin lockers to be near the door, or apart altogether.

CHAPTER II.

FREE AIR SPACES.

Before any definite idea as to space allowance can be arrived at, the most important point bearing on the question of cubic space on board ship, is to know in what manner crew-quarters are occupied, and also the nature of the duties of the different classes of men. For this purpose it will be necessary to class the various grades, taking them in rotation, viz.:—

(1). Officers.
(2). Engineers.
(3). Petty Officers.
(4). Stewards and Cooks.
(5). Sailors.
(6). Firemen and Trimmers.
(7). Lascars „ „
(8). „ (Deck).

(1). *Officers*—In crowded waters and particularly this side of Gibraltar or Port Said, the practice on board many steamers, is for the officers to keep "watch-and-watch," usually kept by the 1st and 4th officers together in the one watch, and by the 2nd and 3rd officers in the other. Then as occasion requires it, the watches are split up into "three watches" kept respectively by the 1st, 2nd, and 3rd officers, the 4th officer being on all day and relieving for meals.

In port, unless the vessel is lying at single anchor, no watch is kept, and officers are on duty all day.

The 1st and 2nd officers have each their separate berth, the 3rd and 4th as a rule being lodged together.

In the coasting trade the two officers keep "watch-and-watch," and in a great many instances live together in one berth.

(2). *Engineers.*—The watches, as in the officers' case, will depend on the number of engineers carried on each vessel. When there are three it may be taken for granted that the "three watches" are adhered to.

In port, unless under banked fires, no watch is kept, and engineers are on duty all day.

The 1st and 2nd each have separate rooms, the 3rd and 4th as a rule occupy the same room.

(3). *Petty Officers.*—Include boatswain, carpenter, donkeyman, and quartermaster. The two former live together, whilst the donkeyman in most cases has a separate berth, but sometimes lives with the firemen.

These men are on duty all day. Quartermasters, when space permits, live by themselves, otherwise they are located with the sailors. They keep "watch-and-watch" at sea, their duty being to steer the ship and keep the time.

(4). *Stewards and Cooks.*—On duty during the day, and are usually located together.

(5). *Sailors.*—Sailors keep "watch-and-watch" at sea, *but not in port*, when the hours of duty are from 6 a.m. to 6 p.m., with intervals for meals; one man being told off to act as night watchman. These men live together.

(6). *Firemen and Trimmers.*—Keep three watches when the vessel is under steam. *No watch is kept in port.* Their duties are from 7 a.m. to 5 p.m.

(7). *Lascar Firemen.*—With Lascar firemen the routine differs but slightly from that of their European *confrères.* They have their separate quarters.

(8). *Lascars (Deck).*—Keep what is termed a "Coolassie watch," which is really no watch at all. At sea or in port they must be ready to turn out at any time. This rule, however, is diversified in some vessels by the fact of perhaps three "pooree wallahs," or watchmen, being on duty at night time.

It will thus be seen that officers and engineers cannot much complain as to the apportionment of berths. Still, it is to small cabins, and such as are occupied by stewards, cooks, quartermasters, and sometimes sailors and firemen, that the question of over-crowding will mostly apply, and also to the larger quarters occupied by sailors and firemen in passenger vessels.

An idea which has given rise to much discussion and which has been used as an argument against increased cubical allowance, is that sailors and firemen always keep "watch-and-watch," half of them being on duty at all times. As a matter of fact, the above shows but too clearly this is not the case; and that in port, where the atmospheric conditions are less favourable, the men at night time will be congregated together.

An attempt has been made by the author of "Suggestions to Managing Owners and their Captains," to refute the acknowledged testimony of experts as to the cubical allowance for each seaman being inadequate. He appears to close his eyes to the fact that the Royal Commission on Labour of 1894 recommended an increased air space of 120 cubic feet for each man. It is not on sea conditions that calculations should be based, but on those which obtain when the vessel is lying in port, where the crew are assembled together in places where they not only sleep but have to live. Moreover, a ship,

unlike a house, possesses the disadvantages of interrupted ventilation due to equable temperatures and stormy weather, and also to the material of which everything is constructed.

As stated under the heading of Lower Forecastles, the Merchant Shipping Act of 1894 differs in no sense from that of the 1867 Act with respect to cubic space. They both state that "Every place in any ship occupied by seamen or apprentices, and appropriated to their use, shall have for every such seaman or apprentice a space of not less than 72 cubic feet, and of not less than 12 superficial feet, measured on the deck or floor of such place."

The rule for computing the superficial area of the deck or floor contained in the new "Instructions to Surveyors," 1895, will be of interest. It states in paragraph 62:—"The place being first sufficiently cleared and clean, and in a fit state for measurement, measure the length in a straight line from the foremost boundary of the floor of the crew space (whether such foremost boundary be the stem, or knightheads or water way, or breast hook, or a bulkhead, or that part of the floor beyond which men cannot properly stand or move about) to the aftermost boundary of the floor of the crew space. Divide the length so taken into four equal parts. At each of these points of division, and at the foremost and aftermost boundaries of the crew space, take a breadth across the ship between the boundaries of the side as defined before; number the breadths so taken as Nos. 1, 2, 3, 4, 5, commencing with No. 1 as the foremost boundary, and ending with No. 5 as the aftermost boundary. Multiply the first and last breadths by one, the second and fourth breadths by four, and the third breadth by two. Then multiply the sum of these products by one-third of the distance or common interval between the breadths, and the product will be the gross area of the floor of the crew space. From this gross area deduct the gross area of all incumbrances, such as hatchways, chain pipes, ventilating trunks, windlass, riding bitts, &c., and the remainder will be the clear area of the floor. Divide this clear area by 12, and the quotient will be the number of seamen for which the space is to be certified, provided that the cubic capacity of the space (as afterwards computed) is sufficient for such number of men at 72 cubic feet per man. The measurements are to be taken in feet and tenths of a foot. *Bed bunks or sleeping berths are not to be deducted as incumbrances, but in cabins there should not be less than* 12 *square feet per man exclusive of the bunk, as the spirit of the Act is that each man should have* 12 *clear superficial feet of deck space.*" The italics are the writer's.

Why the distinction between forecastles and cabins? An interesting instance bearing on this is worthy of note.

A cabin situated in the alley-way of a steamer built in 1875 is occupied by four firemen. Cut into the iron framework over the

door are these words: "Certified to accommodate four seamen." The gross cubical capacity of the cabin is 311·5 cubic feet. The incumbrances are many, and do not appear to have been taken into account; for instance—

Food lockers occupy a space of	14	cubic feet.
Four bunks (including bedding),	20	,,
Four regulation life belts ..	2	,,
Seats and two tables	0·5	,,
Total incumbrances ..	36·5	cubic feet.

Now, deducting the total incumbrances, 36·5 cubic feet, from the gross cubical capacity of the cabin, leaves a free air space of 68 cubic feet for each man. This is without making any allowance for personal effects carried in bags or chests, or for the bulk of the occupants.

The floor space per man, inclusive of the bunk, is 12 square feet. Another feature in connection with small cabins is the too great liberty allowed to members of the crew in making additions to these places in the shape of food and clothes lockers, &c., all helping to make the air space less.

The limited floor space 12 ft. is no doubt a drawback. Add to this the idea that because a place is certified for so many men, the same quantity of bunks are necessary, with the result that a number of sleeping berths are unoccupied. This will apply to a large number of vessels outside of the passenger trade.

Bunks should be built clear of the vessel's side or bulkhead to allow of a free current of air to surround the occupant. The length and width ought never to be less than 6 ft. 6 in. and 2 ft. 3 in. respectively. All the framework should be of iron.* The sides or rolling boards not deeper than 8 inches. To be divided off at foot and head by boarding to within 6 in. of the deck or bunk overhead. The height of the lower bunk from the floor should be calculated by the height of the forecastle, as a greater distance from the floor than the minimum 12 in. allowed by the Board of Trade is to be desired.

As regards the forecastle, an improvement is noticeable on a great many lines, but in many instances it is due to fewer hands being carried than formerly.

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* "Practical Hints on the Hygiene of Ships," by Dr. Collingridge, Medical Officer of Health, Port of London.

CHAPTER III.

BILGES.*

In speaking of "the bilges" here, it must be understood that it is intended to indicate those parts of a vessel where waste liquid matters from the interior finally lodge. Technically the "bilge" of any vessel is a certain defined area, the position of which is invariable.

Roughly speaking, the bilge of a ship is a channel or water course covering the whole breadth of the vessel's bottom, between the frames, and the outer skin and ceiling, Fig. (A) (*a*) (*a*).

In vessels that have a double bottom or water ballast tank, Fig. (B), the space (*b*) (*b*) at the bilge forms a gutter way at the sides. In either case it will receive leakage from any part of the vessel below the main deck line, drainage from cargo, and water which is the result of the condensation common to all iron vessels.

Fig. (A).

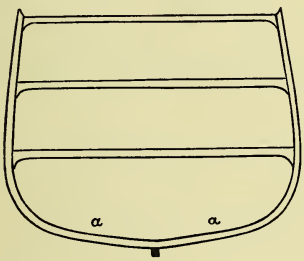
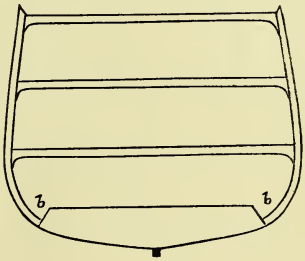


Fig. (B).



"Gutter" bilges offer greater facilities for cleansing purposes than other types, as access is easier to all parts, and they are therefore not so likely to become neglected. Unless, however, there is a tight ceiling, dirt will accumulate on the tank top, and may give rise to a serious nuisance.

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* BILGE.—That part of the floor of a ship upon which she would rest if aground; being that part near the keel which is more in a horizontal than a perpendicular line.—Dana's "Seaman's Manual."

The term "bilge" (derived from bulge) is applied by shipbuilders to this part, and by sailors to the cavity in which offensive liquid known as bilge water collects.—"Marine Hygiene," by Dr. Armstrong.

To ply the pump, and no means slack
May clear her bilge, and keep from wrack.

Olia Sacra (1648), p. 162.

Bilges have in some instances been compared to the drains of a house; this is erroneous, as in no sense can they be so compared, the former are primarily a necessity for the safety of the ship, whilst the drain of a house is a channel by which means all fœcal and other matter is removed, which on shipboard goes direct over the side, thus the functions of the one are different to that of the other. The comparison is misleading, and the word "drain" a misnomer as far as a vessel is concerned.

In emigrant vessels fitting-out, the first care of the Surveyor is to inspect the bilges in order to see they are clean, thus clearly demonstrating that the importance of this is recognised. Unfortunately, a stagnant bilge soon becomes foul, and no provision is made to cut off effluvium conveyed by scupper pipes.

In living quarters below the main deck, there is always a danger of the air becoming polluted by a foul bilge.

Dr. Collingridge, Medical Officer of Health for the Port of London, states in his "Practical Points on the Hygiene of Ships," read before the Shipmasters' Society: "The first point for consideration in the health of a ship should be her bilges. Into these there is a constant passage of water containing putrescible organic matter, which, collecting and becoming mixed with a certain amount of salt water, rapidly decomposes, and tends to seriously affect the health of all on board. Not only have these products of decomposition a generally unhealthy effect, but there is no doubt as to the conveyance of certain diseases, especially cholera, yellow fever, and malarial fevers."

Engine room bilges, being easier of access, are better adapted to cleansing than the bilges in other parts of a vessel. Yet it must be admitted, that the frequent purification of these is a custom more honoured in the breach than in the observance. This may be due to an idea prevalent among many people, that most smells should be treated with "disinfectants." The sooner such ideas give way to habits of real cleanliness, the better it will be for all concerned.

The position of stokehold bilges differs considerably. In some vessels they will be found immediately below the platform, as in Fig. 9, where they can be got at at all times, whilst in others with ballast tanks they are at the sides, Fig. 10 (*d*) (*d*), in which case they are under bunkers, and consequently not easy of access.

The sources of pollution are common to most vessels, but few people, except those immediately concerned, have any idea how foul the bilges become. Lack of proper systematic supervision leads to a serious nuisance, viz., the frequent use of the stokehold as a urinal by those employed there. The urine finds its way to the bilges, and steps should be taken to put a stop to this practice. Another source of pollution is soapy water, the result of personal ablutions and washing of clothes. Such water soon becomes foul, and a serious

nuisance. The residue of oil from engines, works itself into grease balls, which become putrid and add to the nuisance. Side bilges are said to become more foul than others, mainly due to the fact of their being under the bunkers and not easy of access.

It may, however, be taken for granted that, notwithstanding the most favourable conditions, sanitation will not prevail unless there be a local system of supervision, exercised and enforced by engineers, to ensure proper means being taken towards mitigating evils always present in these places, discipline being an important factor in promoting a high standard of excellence.

Fig. 11 is a plan showing the bilges at the sides of the water-ballast tanks, and also the pumping arrangements for both bilges and tanks.

Besides the mechanical means for emptying the bilges from the engine room, the diagram shows the position of the sounding pipes and the hand-deck pumps.

The position of the air and sounding pipes of the ballast and peak tanks are likewise shown. The ballast tanks are filled at (*a*) on the port side, and are emptied by the same filling pipe connected with the donkey pump, the valve at the vessel's side being closed for the time being. Therefore, it will be seen that the bilges and tanks are under the immediate control of the engine-room staff.

The ship's carpenter plays an important rôle as far as these matters go, because upon him lies the responsibility of ascertaining and reporting a true record of the soundings of all wells, tanks, and bilges at frequent intervals during the day, but in most vessels at 8 a.m. and 8 p.m., a record of which is kept on a "soundings" board usually found at the top of the engine-room ladder, which the engineer going on watch cannot fail to see; besides this, the carpenter reports to the officer on watch, who in turn makes a note of it in the day log.

The position of air and sounding pipes in living spaces is a matter of serious moment from a hygienic point of view. As the caps of these pipes have to be taken off when the filling and emptying of the tanks takes place, it can be well understood that the air in such places is open to pollution from the foul gases generated in an empty tank, and from polluted water. Another question arises, in so far as this is concerned, namely, the expense in time and money which attaches to the regular cleansing of these honeycombed structures in the bottom of the vessel, hence it is obvious the cleansing will sometimes be shirked, thus aggravating matters which could be remedied by having such connections anywhere but in living spaces.

It is within the writer's recollection that a complaint was made to him by one of the crew, berthed in the alley-way, as to a smell arising from an ill-fitting cap, the ballast tank having been filled at a port where the water was stagnant and sometimes putrid.

CHAPTER IV.

VENTILATION.

Many improvements affecting the internal economy of ships, and involving considerable expenditure are constantly being carried out; but it is doubtful whether the same remark will apply to the important subject of ventilation. Judging by the multifarious methods by which crew and cargo spaces on board vessels are ventilated, it is evident that the subject, up to this, has received but little practical consideration, and the question of efficiency to a very great extent ignored.

From the ill-directed ventilation so commonly met with, it would appear that ventilators are only an afterthought, and that conformity with the provisions of the Merchant Shipping Act, irrespective of the position of ventilators, is all that is needed. This is an obvious mistake. The usual practice frequently leaves much to be desired. This is due to a want of care in locating ventilators, these being invariably found immediately over or near to bunks, or in such a position that in stormy weather they have to be closed.

Sir James Clarke in his work "The Sanitary Influence of Climate," states:—"To understand the proper method of ventilating we have only to attend to the currents which take place naturally in all inhabited rooms. Air, as it increases in temperature or becomes loaded with watery vapours, has its weight diminished and ascends. Now the air in an inhabited apartment being both heated and generally combined with a portion of watery vapours from respiration, &c., becomes specifically lighter, at the same time that it is vitiated, and rises to the roof. If it had the means of escape it would be gradually forced out by an equal quantity of pure and more dense air entering from below, which in its turn becoming heated and deteriorated, would in like manner ascend and make its escape, thus would a continual current of the air circulate without any trouble on our part. Unless provision be made for the escape of the ascending current of impure air, no admission of external air will secure proper ventilation."

From the following table by Professor de Chaumont, it will be seen that the increase of impure air is greater in the smaller spaces than in the larger.

	Ratios of impurity found in Spaces of 1000 c. ft.	Spaces of 500 c. ft.
After 1 hour ..	0·12 per cent.	0·18 per cent.
„ 2 hours ..	0·18 „	0·30 „
„ 3 „ ..	0·24 „	0·42 „
„ 4 „ ..	0·30 „	0·54 „
„ 6 „ ..	0·42 „	0·78 „
„ 7 „ ..	0·48 „	0·90 „

If such is the case on shore where windows and doors are available, how much more impure must air be in lower forecastles situated in the bows of a vessel where the inlet and outlet are both overhead. In bad weather it is probable that all ventilators will be closed, in which case there is only the scuttle or companion hatch to be depended on. Ventilation under these conditions may be considered non-existent. This is without a doubt the greatest evil that attaches to places below deck, and will apply both to wooden and iron vessels.

Stevens in his treatise on stowage tells us that since the introduction of the plan of erecting cabins above, instead of below the main deck, it has been found that cargoes have been more liable to damage from moisture than they were previously. This has arisen from the stoppage of the ventilation, which was before unintentionally promoted by the fires in the cabins.

This opens out a point in connection with the circulation of air, which takes place naturally in ships with crew quarters situated at each end of the vessel below the main deck. It is well known among seamen, that the effluvium from offensive cargoes and bilge water "goes to windward"; or in other words, when sailing "on a wind," or with the wind opposed to that of the ship, this effluvium is more marked in the forecastle. With the wind aft or in a line with the ship; it will on the other hand be noticed in the cabin only.

Stevens' theory is supported by the manner in which gas explosions frequently occur in coal laden vessels, where the crew quarters are situated below deck, and only separated from the cargo by a wooden bulkhead. The gas finds its way under certain conditions through the wooden bulkhead, and is ignited by the fire in the cabins.

To ensure a proper diffusion of air in topgallant forecastles, without relying on side scuttles, and to obtain efficient ventilation, a method occurs to the writer by which the difficulty might be met, viz.:—

1st.—By having two large swan neck ventilators placed just inside the knightheads, a position affording reasonable protection, Fig. 4 and 4A, (*a*) (*a*) (*a*), and connected below the deck to each side of the forecastle by a pipe.

2nd.—In the passage-way near to the doorway, Fig. 4A (*b*), on either side a cowl ventilator.

With ventilators fitted thus, it will probably be found unnecessary to close them at any time on account of the weather.

Side scuttles or ports, being in close proximity to the bunks, and closed in bad weather, cannot be relied upon for ventilating purposes.

The practice of leading bogey funnels through ventilators is to be deprecated. In wet weather, water finds its way down through the opening at the flange and becomes a nuisance.

On the question of lighting by side scuttles another defect may be mentioned. The angle made by the sides of the vessel, which varies in degree in the different builds, becomes of importance, as the more oblique this is, the worse it will be for lighting purposes. The rays of light being directed more to the deck overhead than elsewhere.

The utility of skylights here, as in other parts of a ship, should be considered, and there should be sufficient light to enable one to read ordinary newspaper type in all parts of the forecastle. The use of light coloured paints will assist towards this end and should not be overlooked.

Access to the fore-peak hatch is generally from the sailors' forecastle, and there is much traffic to and from this place for ship's gear, boatswain's stores, cargo gear, and other materials stored in this part. Frequently cargo is stowed in forepeak, and when this is the case, it must be worked through the forecastle and the men have little chance of keeping their quarters clean. The remedy is not far to seek, as the communication to this place (the fore-peak) should be from the topgallant forecastle deck, or direct from the main deck by passage way. The only objection to the last method would be the fact of taking up too much of the crew space, Fig. 4, (*c*) (*c*). In the case of the former method, in hot climates the trunkway formed by extending the hatchway to the upper deck would, by having two trap doors in the upper part opening into forecastles, give more light and act as an air shaft.

In Fig. 4, (*d*) (*d*), it will be seen that the food lockers in either forecastle are built up against the paint and lamp lockers respectively, a most objectionable arrangement, as the slightest flaw in the usually thin wooden partition will be sufficient to contaminate the food. These lockers should be placed near the doorway or inlet ventilator, and not hidden away in a corner, where they are likely to receive the full benefit of tobacco smoke with which a forecastle is liberally fumigated.

In weekly boats, where the men have to provide their own food, a good meat safe outside the forecastle should be provided, and the common practice of hanging up meat and fish in the forecastle ought not to be allowed.

Another point is the position of lamp and paint lockers. Not only

is the former place fitted with niches and lockers for all the various lamps in use, but it contains tanks in which oil is stored for daily consumption. The trimming and cleaning of the lamps is also carried on in here. If ordinary care be not taken in keeping the place clean it soon becomes foul, giving off a most unpleasant smell.

In most vessels paints are in constant use, and if the locker is situated as in Fig. 4, it will necessitate going into the forecastle, where the noxious smell of paint is, under the circumstances, hardly ever absent. It is therefore evident that such places should never adjoin living rooms, unless protected by an iron bulkhead. On no account should they be in crew spaces.

With the modern type of anchor, hawsepipes form an important feature in the topgallant forecastle, Fig. 4A, (*e*). Owing to the heavy strain to which they are subjected, they are liable to become defective and cause a serious nuisance, so that a certain amount of caution is necessary in fitting bunks near to them.

CHAPTER V.

ENGINE ROOMS.

Notwithstanding the progress which has been made of late years in marine engineering, it is doubtful whether the sanitary conditions of engine rooms, and especially of their necessary adjuncts, the stokeholds, can be considered at the present time to have advanced at a similar rate. In the case of many vessels the contrary would appear to be the case. Economy of space here, as in all other parts of a ship, has the prior claim in construction. This point conceded, it becomes necessary to so study the spaces allotted to those who control the machinery and furnaces, that the highest possible degree of sanitation may be secured. A step in the right direction has been taken by the Institute of Marine Engineers in the discussion of papers on Ventilation. It is to be hoped they will persevere in endeavouring to remedy evils which are sufficiently obvious to those employed. The intense heat is naturally one of the greatest discomforts to be borne in engine rooms, and particularly now that increased steam pressures are being so largely introduced. Little attention also appears to be paid to the proper insulation of back ends of boilers (abutting on divisional bulkhead), cylinders, and steam-pipes. The lower platforms are frequently cramped by side-pockets and storerooms, and efficient ventilation is in almost all cases overlooked.

Now that coal consumption is better understood, and in view of the economy thus effected, it becomes an open question whether side-pockets and lower bunkers should occupy any important place in the construction of engine rooms and stokeholds, or whether indeed they are needed at all. If they are not needed, more air space would be available and ventilation thereby improved.

The common practice is to have the entire system of ventilation in the immediate vicinity of funnels and boilers, a course which is open to many objections, not the least important of these being the fact that with the wind at certain angles the ventilators become practically useless. The question therefore arises whether, with all the mechanical aids to ventilation at our disposal, these large cowl obstructions are required. It is without a doubt necessary to have large and efficient air shafts for intake ventilators, but proper egress must be provided for the imprisoned hot air, in order that a circulating system of ventilation, not liable to interruption, may be

maintained. For vessels trading in hot climates, ventilation by propulsion or extraction would appear the most effective method, for it not only guarantees a sufficient air supply, but also assists in reducing the temperature.

The cramped space round and about machinery is not consistent with the proper diffusion of air, and the necessarily greasy bilge is in direct opposition to the laws of health. These are matters that could be remedied without incurring any further expense. Side pockets, if absolutely necessary, might be sloped down to the vessel's side to about 10 ft. above the lower platforms. A greater width should be given to the engine hatch, with more and larger openings into alleyways, and a skylight running the whole length.

The insulation of boilers (not omitting donkey boilers), steam pipes, and cylinders, with non-conducting material, is a point which would not only conduce to the lowering of the temperature of the surrounding atmosphere, but also assist in maintaining a high internal temperature, with a probable saving of fuel.

CHAPTER VI.

STOKEHOLDS.

Little improvement appears to have been made in stokeholds of the present day with regard to matters affecting the well-being of the men employed there, for the simple reason, that beyond engineers and those immediately concerned, few persons, if any, think of going near these remote and gloomy recesses in search of insanitary conditions.

The usual routine, when the vessel is under steam, is for the stokers, or as they are generally termed, firemen, and trimmers to keep what is called "three watches," that is four hours on and eight hours off duty.

In port the duties differ, for in that case some are "told off" to work in engine room, the hours of duty being usually from 7 a.m. to 5 p.m., with intervals for meals.

Both stokeholds and bunkers may be considered "workshops," where men are constantly feeding and cleaning fires and trimming coal. These fires are attended to from a platform, three to five feet above the vessel's bottom, the most notable feature of which, is its cramped and confined position and area.

It can be understood that places so low down in the ship must in all cases be difficult to ventilate. The conditions, however, vary in some degree in almost all vessels, owing to the fact of few being built on exactly the same lines.

As in the case of engine rooms, but if anything in a more marked degree, abnormal heat is the most unfavourable condition under which the men labour. High steam pressure means a corresponding increase of temperature in the vicinity of boilers, and the need for keener vigilance is apparent as, up to the present time, sanitation in these places has been but a secondary consideration.

The following remarks by an eminent authority on the question of temperature will be of interest.

"One of the most remarkable facts in connection with man is, that when in health he is able to maintain his normal or standard body heat of 98° to 99° F. under the most extreme and opposite climatic conditions. This of course is not always the case, for at times both extreme cold and heat

profoundly affect man's physiological condition. Except perhaps in the tropics, the general effect of direct sun's rays on the body is beneficial; but prolonged exposure to great heat, whether in the sun or in the shade, is accompanied by pronounced physiological disturbance. Some experiments go to show that the body heat itself is increased $\frac{1}{10}$ degree for each degree (Fahrenheit) rise in the air's temperature, while the respiration of those living in hot countries, though at first (some six months) increased, are afterwards so much lessened in frequency that the entire respiratory function is reduced by about 18½ per cent. Much of this lessened respiratory function in hot climates is said to be due to the fact that with a high temperature the quantity of oxygen present in the air is diminished. Thus a cubic foot of dry air at 32° F. weighs 566·85 grs., which, neglecting the slight amount of carbon dioxide present, gives in that cubic foot of air 436·5 grs. of nitrogen and 130·35 grs. of oxygen. Assuming that a man at rest breathes 16·6 cubic feet of air per hour into his lungs, he will at 32° F. receive 2,164·2 grs. of oxygen per hour. At a temperature of 100° F. (which is not unusual in tropics) a cubic foot of dry air weighs 498 grs., and is made up by weight of 383·5 grs. of nitrogen and 114·5 grs. of oxygen. Therefore in an hour, breathing as before, the man would receive 1,901 grs. of oxygen, or nearly 12 per cent. less than he would breathe in at the lower temperature. The action of the skin is increased in hot countries by as much as 24 per cent., but the water exhaled by the breath, and passed off by the kidneys, is proportionately reduced. In hot climates the general functions of the whole body become impaired, notably the nervous system and digestive organs, which, from being the seat of more or less increased action, are peculiarly liable to become congested and enlarged. The essential requirements for the bearing of great heat by the body is the maintenance of abundant perspiration; the moment this fails the heat equilibrium is disturbed, and the body heat rises rapidly, accompanied sooner or later by insensibility and death from heat-stroke." *

Without a doubt, abnormal heat is the firemen and trimmers' greatest foe. It will vary in different vessels, there being no uniformity in construction, and according to the method of ventilation adopted. In a measure also it will depend on the type of boiler, but the following remarks will apply to nearly all cases:—

When the direction of the wind is at right angles, or in a line with the ship, that is abeam or abaft, ventilators of the cowl variety are next to useless, consequently the little air that can be obtained is by induced currents, and is all that can be relied upon. Under these conditions, for men to remain stoking four hours without going on deck may be possible in high latitudes, but it is practically impossible to do so in hot climates, when the temperature is between 110° and 140° F. It is a common occurrence for the men to go on deck after every "fire up" for fresh air, in a half-exhausted state, and in clothes dripping with perspiration, to encounter a difference of temperature of from 30° to 60°. Under these circumstances the same rate of speed cannot be maintained as when the men might

* Hygiene by Prof. Notter and Surg.-Major Firth.

remain below, it being well known that there is a difficulty in keeping up the proper amount of steam when these conditions exist.

When the wind is blowing in a direction opposed to that of the ship, that is ahead and before the beam, firemen are able to remain below by standing immediately beneath the ventilators. This they do after stoking the fires, or as it is termed "firing up," an operation which occupies four or five minutes, thus exposing themselves in their enervated condition to a greater difference of temperature than by going on deck, a proceeding which cannot but be deleterious to health. In the side bunkers, and particularly the lower ones, the heat from boilers is invariably greater than the heat in stokeholds. Here again may be noticed the want of efficient ventilation, so that, what with the dirty nature of their work, the trimmers' lot is if anything worse than the firemen's.

Fig. 10 represents the stokehold of a new vessel of about 4000 tons, employed in the foreign trade. Having two high pressure boilers (*a*) (*a*). Depth of hold from fiddlee (*b*) (*b*) to lower platform (*c*) is about 40 ft. This place is ventilated by two 24″ ventilators (*d*) (*d*), situated in the space between the funnel (*e*) and stokehold bulkhead (*f*), Fig. 12, which at the opening in fiddlee (*g*) is 12 ft. by 4 ft. This space is intersected at certain altitudes by iron gratings, (*h*) (*h*). The egress for the hot air is by the funnel cape, (*i*) (*i*) and two 12″ ventilators, (*k*) Fig. 12, abaft the funnel; this being totally inadequate, and better means could have been provided without affecting the question of seaworthiness. Four of the furnaces, (*l*) Fig. 10, being 4 ft. 6 in. above the platforms, will consequently entail more work for the men, a fact well worth considering, because under the most favourable conditions the exposure to the immediate vicinity of the radiant heat cannot be entirely remedied. Again, the labour of the men will be further enhanced by the quality of the coal used; with Japanese and other Eastern coal, fires require frequent tending and more coal. The products of combustion will be increased, and consequently more ashes to heave up at the end of the watch.

Fig. 13 represents the engine room and stokehold of a vessel of about 1000 tons, employed in the coasting trade of this country, with a depth of hold of about 22 ft. from the fiddlee to the lower platform, the space between the furnaces and stokehold bulkhead being about 7 ft. 5 in. This place is ventilated by two 27″ cowl ventilators; and whether these will always prove effective and sufficient in admitting fresh air into the stokeholds under all conditions, except with the wind ahead or before the beam, is a question which may be answered in the negative. The exception indicated is their only commendable point, and it cannot be said that they will even then cause a proper diffusion of air in all parts of the stokehold; consequently this means of ventilation cannot be relied upon. In the first place, there is too little space on the platform, the venti-

lators are too near the funnel and boiler, and the egress, (*a*) Fig. 13, for the hot air is inadequate.

Representing, as this diagram does, the average vessel in the coasting trade, where the temperature in the stokeholds in the summer months is between 100° and 125° F., and where there is only one fireman on watch at a time, who has to do both the trimming and stoking, it can well be understood that work carried on under these circumstances must be a great strain on one man.

Good ventilation goes a long way in making a cool stokehold, but at present unfortunately it is only partial and ill-directed.

Fig. 14 illustrates the method in vogue of utilizing ventilators for the purpose of raising ashes from the stokehold, a practice which is open to condemnation on account of obstruction.

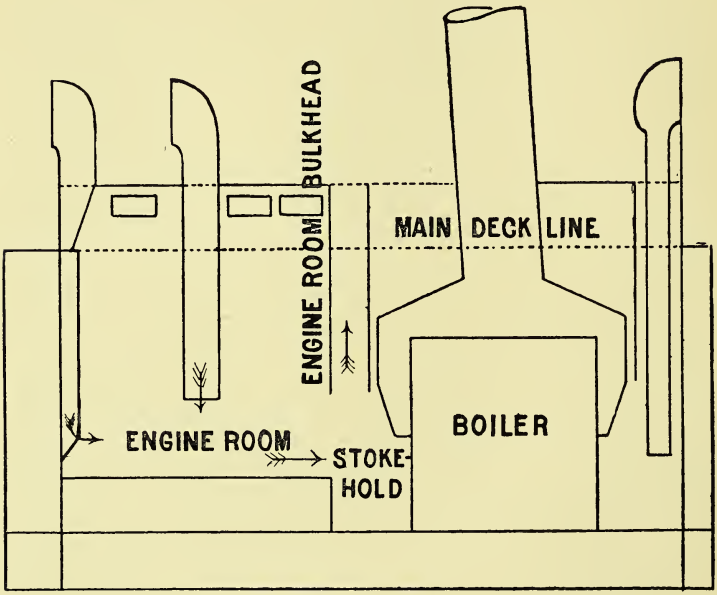
The inlet of stokehold ventilators, in some cases, are at times screened by bridge obstructions (see Fig. 15) in the shape of dodgers, awnings, and screens, a state of things which tends to nullify any attempt at ventilation.

The absence of sufficient space on lower platforms will in a great measure account for the close atmosphere common to all stokeholds. The lower side bunkers (*a*) (*a*), Fig. 9, take up too much room; but if, as shown by the dotted line, they were sloped down from between decks to the vessel's side, *i.e.*, from (*b*) to (*c*), no great sacrifice of bunker accommodation would be made, and it would provide sufficient means for getting round boilers, thus assisting the circulation of air. In addition, the bare sides of the vessel would tend to reduce the temperature. There should be at least 10 ft. space between furnaces and bulkheads or bunkers, and sufficient space above the uptake of boilers, so that the escape of hot air should be facilitated in every possible way. Periodical limewashing, say once every six months, would assist in some measure in keeping the air of the place sweet.

Captain Froud, Secretary of the London Shipmasters' Society, at a discussion on ventilation of engine-rooms and stokeholds, at the Institute of Marine Engineers, gave as his experience that it was easy to secure good, if not perfect, ventilation of engine rooms and stokeholds, and in describing the following diagram stated:—

"Considering the spaces in question as one pit, I devide it unequally by a perpendicular brattice, extending from top of fiddley to orlop beam from side bunker to side bunker; the columns of air in the two shafts are unequal in height—the smaller (stokehold) one extendiug to top of fiddley, the larger (engine-room) stopping short of that height by some three feet, that being the bottom of large opening in sides of engine-hatch. The heated and consequently lighter air in stokehold shaft sets going the circulation, which by the way is helped and directed to some extent by inlet ventilators, one carried down after bulkhead of engine-room to below bottom stroke of piston-rod, another one over starting platform, and another over condenser.

The result is a constant steady rush of air to the fires, and up the stokehold shaft as shown in accompanying sketch."



The foregoing remarks apply mainly to ships with one stokehold without ventilating cowls. Where there are two stokeholds the forward one is fitted in the usual way, the after stokehold always remaining the up-take.

Captain Froud has in no way over-estimated the importance of this simple and natural method of ventilating these places. A series of temperatures taken through the courtesy of Mr. F. Parkinson, chief engineer on a vessel of this description, on a voyage to the Mediterranean and back, will be of interest, as showing that the wind at any angle had little, if any, influence in securing the natural circulation of air in the engine-room. And further, the average temperature of the place for the 23 days enumerated, was only 12° greater than that of the deck.

There is an open space in the lower part of the bulkhead which separates the engine-room from the stokehold; this opening is 12 ft. in width, by 6 ft. in height. The temperatures in the first three columns were taken in this open space, at a distance of about 7 ft. from the furnace doors. The steady current of air converging

Temperatures taken in Engine Room and Stokehold of SS. — of London, Official No. — on a voyage to the Mediterranean.

Place.	Date.	Direction of Wind	At Bulkhead (open space) between Ehgine Room and Stokehold.			In Engine Room 8ft. abreast of Engines forw'd.		Sea Water.	Shade Temp. on Deck.	Tunnel half-way.
			Port side.	Mid-ships	Starb'd. side.	Port side.	Starb'd. side.			
	1896.									
Gibraltar to Malta	June 25th	Wind aft	86	85	85	87	83	65	78	67
Do. do.	„ 26th	On port beam	88	86	83	89	84	67	79	69
Do. do.	„ 27th	Do.	88	87	84	88	84	70	74	73
Do. do.	„ 28th	On port quarter	88	86	84	89	84	72	76	76
Do. do.	„ 29th	Right aft	84	84	84	88	83	70	72	74
Malta to Preano	July 1st	Aft—light	88	87	86	90	87	72	82	75
Do. do.	„ 2nd	On port beam	88	88	88	91	88	74	76	76
Preano to Constantinople	„ 4th	Ahead	91	91	90	93	90	74	80	77
Varna to Odessa	„ 11th	On port quarter	85	84	84	86	84	72	74	73
Odessa to Marianople	„ 15th	On starboard bow	88	88	88	88	88	68	79	78
Marianople to Constantinople	„ 29th	On starboard quarter	97	97	94	100	90	72	80	79
Do. do.	„ 30th	Aft	100	100	97	101	94	76	86	80
Constantinople to Malta	„ 31st	Aft	98	98	95	98	92	76	83	79
Do. do.	Aug. 1st	Calm	98	97	94	98	94	76	87	79
Do. do.	„ 2nd	Do.	106	105	96	103	95	80	88	82
Do. do.	„ 3rd	Do.	108	105	107	104	96	81	90	84
Malta to Gibraltar	„ 4th	Fresh wind on port quarter	98	98	95	98	93	78	90	81
Do. do.	„ 5th	Fresh head wind	101	90	97	101	95	78	88	80
Gibraltar to St. Vincent	„ 6th	Strong head wind	99	98	94	99	82	77	84	81
Do. do.	„ 9th	Aft—light	90	88	85	90	85	70	77	74
Off Berlings	„ 11th	Strong head wind	84	80	79	85	79	59	72	65
Bay of Biscay	„ 13th		86	82	80	86	81	67	72	74
English Channel	„ 15th	On port beam	81	80	78	81	78	62	69	70

towards this opening is induced by the fires and by the heated or lighter air of the stokehold, the air supply being drawn from the tunnel, ventilators, and other openings leading into engine-room. The heated air in the stokehold has ample means of escape by fiddlee gratings and by the original stokehold ventilators which, are now only used as ash shoots, the cowls having been removed to prevent obstruction in the air current.

The temperatures taken midway between the two engine-room bulkheads, and at a place where the engineers on duty keep watch, points to the value of this system for ensuring a cooler engine-room. On the 1st, 2nd, and 3rd of August during a calm, the deck temperatures were 87°, 88°, and 90° respectively, and in the engine-room (starboard side) the temperature at the same time was 94°, 95°, and 96°, making a difference in this respect of only 7°, 7°, and 6°, greater than the outside atmosphere. Considering these were the hottest days during the voyage with the highest sea-water readings—the most trying time it may be said—we find that the circulation of air was in no way retarded, but on the contrary if anything, it was assisted.

One very important factor in this method is the utility of the tunnel as a ventilating shaft. By this means a cool current of air is drawn into the engine-room. The ventilation of engine-rooms and stokeholds needs more care and attention than it has hitherto received. The alarming increase in the number of suicides in these departments is such as to call for immediate legislation. The necessity for such action is already recognised by the Imperial German, and by more than one of our Colonial Governments.

A study of the return of deaths issued monthly by the Registrar-General of Shipping and Seamen is of interest, as it concerns a class of men who in many instances have fallen a prey to their work. These men are the firemen and trimmers, about whom the world at large knows little, and as a rule they receive but scant sympathy from the nautical profession, otherwise more vigorous sanitary reform would be manifest.

It may be true, in most cases, that the firemen and trimmers are composed of men who have been forced to take to this work for want of other employment. Still, there is little doubt that a large number are attracted to it by the wages, which are higher than those paid to sailors, a point worthy of note as showing that the duties are recognised as being more arduous, or even more dangerous. Their work cannot be considered more *important* than that of the sailors who are responsible for the safe navigation of the vessel. Physically, there is no difficulty in distinguishing them from other members of the crew, as they carry the impress of their calling in their emaciated and frequently exhausted appearance.

CHAPTER VII.

BERTHS NEAR ENGINE-ROOM AND STOKEHOLD.

The position of berths adjacent to engine-rooms and stokeholds, and in a place that cannot be at all times used for living purposes on account of heat, is a matter that requires serious attention. Unfortunately these faults are too common in our mercantile marine, the trade of which is both to and in hot climates. Living-rooms in or near such places under these circumstances offer many objections and discomforts. Members of the crew find that from the high temperature repose is impossible. This is a matter in which the Administration might interest themselves, because on this in a great measure depends the question, whether an officer or engineer, if he has not had the necessary rest, can keep a good watch, the only safeguard against "napping" when on duty.

The proverbial saying on board ship that "a hot engine-room and stokehold make a hot ship," should convey to the ordinary observer a palpable meaning—there being no effect without a cause. This to a very great extent illustrates the connection between living rooms, and boiler and engine-room spaces through the medium of heat, a factor up to now not sufficiently considered in locating berths. The conductive properties of the iron of which everything is constructed in these departments, enters largely into the subject, as by this and other means heat is conveyed to the immediate surroundings from the boilers, steampipes, funnels, &c., through the agency of stokehold bulkheads, bunker, boiler and engine-room casings, &c. Owing to this, crew quarters situated over boilers (main and donkey) and within the range of conductivity are in certain trades rendered uninhabitable.

To the sanitarian heat will be an additional element to contend with on board ship, and one in which numerous difficulties will have to be overcome, but with care and a strict adherence to details, improvements can be effected. At the same time it must be remembered, that in locating berths there are certain untenable methods in vogue, which call for speedy remedy.

The prevailing system of berthing engineers in the immediate surroundings of their departments for the sake of convenience, is decidedly wrong, and the sooner this gives way to improved methods the better it will be for those whose work at the best of times is trying.

Berths in engine-room and stokeholds are exposed to sudden

changes of temperature, deleterious emanations from bilges, sickly smell of oils, the moist atmosphere always present, and *the danger that may arise from the bursting of a steam pipe.**

Fig. 16 illustrates the position of the 1st and 2nd engineers' berths on either side of the cylinders, with doors opening out on to top platforms. These rooms are always damp. This is due to condensation. The only ventilation is by a circular louvred ventilator in the door, and the side scuttle or port, which cannot always be opened.

Fig. 17 illustrates the crew quarters on a vessel employed in the coasting trade of this country. The seamen and firemen's quarters are over boiler tops and adjoining engine-room, the overhang of these places being about 2 ft. from boiler.† The extreme width being 6 ft. The saddle back is sloped down to within 3 ft. of the vessel's side, leaving but a narrow passage abreast of it. On the starboard side in the seamen's quarters is a steam winch exhaust tank which, when the winches are at work, becomes hot and consequently a heat generator. This tank is only protected by half-inch boarding. On the after part and adjoining the firemen's quarters on the port side abreast of cylinders in engine-room, is the 1st and 2nd engineers' berth, access to which is from the top platform. The berth is 9 ft. in length, by 6 ft. in width, and is fitted as a mess room and sleeping room combined.

The space these quarters occupy is virtually what is termed the side bunkers, the cubical capacity of which has been deducted from the register tonnage. Could not these places be used as coal bunkers in lieu of the lower side bunkers, which as a rule take up so much room in the stokehold? This indeed would be a great improvement, and there would be no difficulty in finding better quarters for the crew.

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* *Vide*—The accident which occurred on the S.S. Brigadier of Newcastle, Offl. No. 7263, when at sea and about 40 miles from Hartlepool. On the 6th November, 1875, an explosion took place in the engine-room, which resulted in the deaths of two firemen as follows:—The junk ring of the high pressed cylinder gave way, the cylinder cover in consequence being knocked off, caused the steam to exhaust in engine-room. Two firemen asleep in their bunks at the time of the accident, were found dead on the upper platform in endeavouring to escape from their quarters, which were situated on the after part and in engine room.

† Captain A. G. Froud, Secretary Shipmasters' Society, in his paper entitled "Heating of Ships and Cargoes," states:—"Cabins near the boiler-room, and especially if over or abreast of the boilers, are uncomfortable by reason of the heat. If used for passenger accommodation at all, these places are fit for bath rooms and lavatories only."

"The overhead part of the donkey-boiler recess becomes very much heated when the boiler is in use. It has become a general practice with ship designers to place the donkey-boiler in a recess of the reserve bunker. The plan is common but without reasonable excuse."

For security and handiness, it must be admitted that berths in alleyways (Fig. 19) offer certain advantages. On the other hand there are many disadvantages, because in the typical vessel of to-day, the mode of construction and location of these berths cannot be commended. In most cases their position proves beyond a doubt a want of forethought in making allowance for local influences and climatic changes. As a matter of fact, berths are built up against stokehold and galley bulkheads. Officers and engineers' rooms and mess rooms will be found opposite to stokehold and galley doors, where also there will be closets, paint, and lamp-lockers and store-rooms.

The ventilation and internal fittings of berths also show a lack of care in the arrangements, this being frequently carried out in a most haphazard manner.

Fig. 19 represents the berths in the alleyway near the stokehold on a vessel which has been trading to the East for a number of years. The 2nd engineer's and the cook's berth amidships are adjoining the stokehold bulkhead, and immediately above the donkey boiler, Fig. 20.† In either of these rooms there is a port-hole in the bulkhead, no doubt originally meant for lighting and ventilating purposes. There is also in each room a square window which opens into alleyways (*c*), the lower part of which being level with the top bunk, would, when opened, expose the occupant to a draught. Opposite to this window on the other side of the passage, at a distance of about 4 ft., is the closet.

Fig. 18 shows the berths with the bunks at the side of the vessel under the half round, a position open to many objections, primarily owing to the fact that in high and low latitudes they are found to be either abnormally cold or hot, as the case may be. The conductive property of iron as regards cold or heat is not sufficiently taken into account, and the usual wooden lining is no protection; still the remedy will not so much depend on non-conductors as on the position. By having the bunks fitted against or near to the fore and aft bulkhead, instead of at the side, a more equable temperature at all times would be ensured. Again, side-ports, so commonly relied upon for ventilating purposes, will, if these means be adopted, be of more practical use, as the need for closing them will in a great measure have been removed.

If a continual current of air could be maintained through the alleyway, to carry off the heated and sulphurous air from engine-room and stokehold, no better system of ventilating berths than by admitting air from the alleyways could be adopted, as the need for closing ventilators would not arise; but unfortunately it is not so, for the direction of the wind will often cause interruption of the draught, as also will cargo and bunker coal when carried there. Consequently this system is to be deprecated under all circumstances.

Fig. 21 is a plan showing living-rooms adjacent to engine-hatch, below the half bridge deck, and in the immediate surroundings of engine-room, with doors leading thereto. These quarters are in no way protected from the heat transmitted from the engine-room and the iron deck overhead; consequently in temperate climates in the summer months these rooms are abnormally hot, and at times unbearable.

The defects indicated are of course intensified in vessels trading in hot climates, as no through draught can be obtained to carry off the hot air, so that sleeping and taking meals on deck are resorted to.

Fig. 22 is a plan of the main deck showing arrangements of berths below the bridge deck (see section elevation, Fig. 23). Access to these places is by a scuttle hatch on the starboard side of the bridge deck, and from a door leading from the stokehold. It will be seen that the 2nd officer and cook's berths are situated between the galley and the stokehold bulkhead. It is obvious that these berths are practically useless, as no amount of sanitation will render them habitable under the circumstances, and yet these rooms are recognised as crew spaces by the Board of Trade. This vessel has been in the China trade for a number of years.

Fig. 24 illustrates the position of officers' and engineers' berths and mess room below the main deck adjoining the engine-room bulkhead. It also shows a closet on either side abutting on to the berths, with doors opening into mess room. This without a doubt is very objectionable, as the average closet below deck is a nuisance.

CHAPTER VIII.

WATER AS SUPPLIED TO VESSELS IN FOREIGN PORTS.

We now come to a most important point—the supply of good water. At all times and in all countries and climates, its possession has been looked upon as a prime necessity—its absence as a grave calamity.

To the maritime life of the world these conditions apply with particular force. From time immemorial, we have heard of the sailor's "pound and pint," and many instances have given us food for reflection on reading of a vessel arriving in port with scurvy on board, short of provisions, and short of water. These instances are fortunately few and far between at the present time, vessels are better equipped, due no doubt to improved education, and the stringent measures adopted by the Board of Trade, in promoting a wholesome supply of provisions and water, a result proving beyond question how wise and useful these have been, still the measures adopted do not cover the whole question of the water supply, as they only ensure clean tanks and good water at a home port, of which, unlike provisions, a sufficient quantity cannot be carried for the round voyage, consequently the responsibility still rests with the shipmasters of safeguarding as far as lies in their power, the health of the crew under their charge. Unfortunately it is a subject to which they have given too little heed, and knowing that bad water means a sick crew, it is surprising no action has been taken on their part in reporting on some of the ports, where sickness has been traced to this cause.

It must be borne in mind that on shore the quantity of water the average man will drink varies considerably, depending mostly on the season of the year and the nature of his work. The same, but to a greater extent, will apply at sea, where the only beverage is water, and where the climatic changes are more frequent. With those employed in engine-room and stoke-hold departments, the quantity that is drunk in hot climates, when the vessel is under steam, is enormous, varying in quantity from one to one and a half gallons or more per man for four hours. Is it then surprising that the engineering staff feel the first ill effects of impure water? No wonder diarrhœa is so prevalent in these departments.

Dr. Armstrong, in referring to the contamination of drinking water in his work "Marine Hygiene," states: "M. le Fevre has demonstrated beyond dispute that 'colique vegetale' was nothing more nor less than lead poisoning, due chiefly to impregnation of the drinking water with that metal from the tubes of a distilling apparatus

then in the use of the French navy, the solder of joints in connection with the feeders of water tanks, &c. The large amount of water consumed by stokers at once accounted for the great prevalence of the disease among this class."

Certain ports in the Mediterranean are noted both for the indifferent quality, and the method of supplying water to vessels. Gibraltar ranks first; the ordinary tramp steamer avoids as far as possible taking water here on this account, the water supplied to vessels having the reputation of being brackish, and the antiquated method of taking water off in the casks is still resorted to.

Drinking water supplied to vessels at Constantinople comes principally from Bëresk on the Bosphorus and also in smaller quantities from the supplies of the Scutari Water Company. The water boats employed in this service are of wood and no supervision is exercised over them by Port Authorities, with the exception of their being numbered and registered. The water may be pure, but what does this avail, if these wooden water boats, which have been working for years, are not under strict supervision to ensure periodical cleansing and repairing? Again the keen competition that goes on in this place is hardly consistent with the object of obtaining a wholesome supply.

Ports situated on the delta of the Nile are mostly dependent on Nile water. Alexandria is noted for its bad supply. Traders avoid as far as possible filling up here, and when they do, this water is mainly used for cooking and washing purposes. Can it be that the water boats are not properly looked after? This should be of particular interest, seeing that cholera is almost endemic in the neighbourhood.

An instance which came under the personal observation of the writer will perhaps be of interest as regards Port Said, which is also supplied with water from the same source.

Discharging, together with another steamer, at Port Said, we both subsequently proceeded to Batoum. We did not water at the former place owing to one of the Port doctors informing us (on enquiry) that the water was full of organic matter, in consequence of the Nile being low, in lieu thereof we condensed a sufficient quantity to take us to Constantinople; the other steamer not taking the same precautions, received her supply at Port Said, and on arrival at Batoum, half the crew were down with diarrhœa and dysentery, but on our vessel there was no sickness.

Marseilles water is not always to be relied upon, whether it is for the want of supervision of the water boats remains doubtful; however, another instance which came under the writer's personal experience is worthy of note.

On a steamer bound from Marseilles to the Black Sea, we took our supply from the former place, and two days after sailing

we were all suffering from diarrhœa. It began first with the firemen, one being laid up who was eventually landed at Constantinople suffering from dysentery. We shipped another in his place, who was laid up the next day with all the symptoms of cholera, and on arrival at Nicolaiev he was taken on shore to hospital.

The water was stored in two tanks, and on arrival at Constantinople, one was emptied and filled with water from there, the other tank with Marseilles water was reserved for washing purposes, and it was this water the new fireman inadvertently drank. On our return journey we filled up our supply at the mouth of the Kherson River for the use of the crew, at the same time condensing for live stock. No sickness occurred after discontinuing the Marseilles water.

There are many other ports in the Mediterranean where not so much the quality of the water is impugned, but the water boats used for storage purposes.

Aden : the supply is condensed water, and is conveyed to vessels in large iron tanks.

Colombo: supply good, boats looked after.

Point-de-Galle: water good, but owing to the little trade done here as a coaling station, the water will be often stored for long periods of time in old wooden water boats.

Singapore: water good, and supplied to vessels direct from the Tangon Pagar Wharf.

River Water.

River water too often finds its way to the fresh-water tank. Derived, in the first instance, from springs, it receives in its course large quantities of surface water contaminated with all kinds of impurities. In malarious districts it will probably contain much decomposing organic matter, and should at all times be avoided for drinking purposes unless distilled before use.

In a general way it may be taken that drinking water drawn from rivers is dangerous—more especially that from the deltas of rivers within the tropics.

On certain rivers it has become quite a custom to seek the pilot's advice as to the best time and place for filling the tanks; this practice prevails notably at the River Plate, Amazon, Mississippi, and the Danube. In the East, the waters of the Hooghly, Bassein, Rangoon,* and other rivers have had their share in giving the old

* Drinking Impure Water.—At an inquest held on the 7th inst., at Portsmouth, on the body of Captain Sorren A. Gundersen, of the Norwegian ship Enterprise, of Tunsberg, who died when off the Scilly Islands, it was proved that his death was caused by parasites conveyed in the water which had been served out on board. The water was taken in from a water boat at

"shell back" endless direful tales to hand down to posterity. Nearer home, and at the Black Sea ports, matters do not improve, as this custom is still in vogue. The Danube water is at the present time coming in for a certain amount of exposure by crews of vessels.

From the official report on cholera at Buda Pesth, by Professor Ludwig Gebhart, it appears that the use of Danube water was regarded as the chief factor in causing the spread of the disease in that city, it being stated that cholera attacked for the most part such persons as had drunk Danube water, whether filtered or unfiltered, whilst, on the other hand, those who had obtained their water supply from springs, or who had boiled the water obtained from the public supply, generally enjoyed immunity. The level of the ground water and the circumstances of the soil were not considered as having exercised any influence.*

Most of the Baltic ports are likewise known for their unreliable water supply, and the majority of vessels trading there during the summer months endeavour as far as possible to make their drinking water last the voyage, using the water obtained at any of these ports for cooking and washing purposes only. Unfortunately very many vessels are unable to do this owing to the limited capacity of their tanks.

In referring to the part played by water in the diffusion of cholera at St. Petersburg, Dr. F. W. Barry in the report, previously quoted, states:—

"It was found that the earliest cases were confined to the workmen in the large factories situated on the banks of that branch of the Neva known as the Great Nevka. The workmen were accustomed to drink water derived directly, without filtration or boiling from this branch of the river, which at all times is charged with much organic matter (14 parts in 100,000), and which produces gastro-intestinal catarrh in all persons unaccustomed to its use. It was at once arranged that water should be supplied to the workmen from the town waterworks, and that this water should be filtered or boiled before drinking. The effect of the change in the water supply was immediate, and there was no further spread of cholera in that part of the city."

The custom, however, is not confined to the workmen in the

Rangoon. Two of the crew succumbed previously, after showing similar symptoms to those experienced by the captain, and were buried at sea. Fresh water was taken in at St. Helena, but did not produce much change. It transpired that the water was not boiled before drinking. – *Gravesend Reporter*, 12th May, 1894.

* Report on the Origin and Progress of the Western Diffusion of Cholera during the year 1892, by Dr. F. W. Barry. Twenty-second Annual Report of the Local Government Board, 1892–3.

factories alone, but to all those employed on the river craft; it is a practice that has extended to vessels trading there, as the supply till very recently was taken direct from the river.

A consular report on the district of Riga (Foreign Office 1894, No. 1337) contains the following particulars:—

"The last choleraic attack at Riga was in November from 12th to 24th. In all there were 53 cases of which 21 proved fatal; the number last year being 151 and 75 respectively."

"The character of the disease was not of such a malignant type as last year; it made its appearance a month later and only lasted 39 days. The persons attacked were mostly from the same localities and of the same classes as those last year; viz., *the labourers at the port, and on board ships, and men engaged on the river, who regardless of the notice published by the Sanitary Authorities prefer to drink unboiled river water.*"

In the face of such facts it is obvious that a great responsibility rests with the shipmaster, and the time has arrived when he should be assisted in such a way, as would relieve him of the constant worry and expense, he is subjected to in this water business.

Could not some ports be fixed where a pure and wholesome water supply could be relied upon? Take for instance all the coaling stations, it would only entail a little strict organisation to ensure this, shipmasters are oftentimes handicapped at these ports, because to refuse water of a doubtful nature, would sometimes mean many hours of detention and a consequent loss to his owner, so that as a rule he takes what he can get.

But until strict supervision is exercised by Port Authorities, it would, in all cases, be better to condense instead of filling up with doubtful water.

On the question of condensing for supply there is not at all times perfect unanimity of opinion between the shipmaster and engineer.

The view that the engineers take is in the direction of increase of deposit in the boilers, and the greater consumption of coal which condensing necessitates.

An instance bearing on this subject will perhaps be of interest.

On a certain vessel bound to a cholera-stricken port, the master instructed the chief engineer verbally to condense for supply to save taking in water at that port. The engineer demurred and stated that the condenser was out of repair, and could not be used. On this the master gave him written instructions to start without delay, at the same time stating that a copy had been inserted in the log. It is needless to say the order was executed well within the specified time, with the result that no water was taken in at the infected port and no sickness occurred on board.

CHAPTER IX.

DRINKING WATER TANKS.

It is not only necessary that the water supply be of the purest quality, but it is also requisite that its storage on board ship should receive particular attention. The receptacles for carrying the supply should be of such material as will ensure its preservation in good condition for long periods. Iron tanks have many advantages, and are generally recommended as being more suitable and convenient. The wooden water casks often found on board ship have been condemned by all competent authorities as unfit for the storage of drinking water.

In many vessels, water tanks are a prominent feature in connection with the stability of the vessel, and are consequently placed low in the body of the ship.

In the larger sailing ships, the tanks are situated in the lower hold amidships, on each side of the pump-well, and are accessible at all times from the deck, a position which is convenient for cleansing purposes. This arrangement, however, is not always found in the smaller vessels, as tanks are frequently found under cabins below deck, and sometimes even under lower forecastle floors, situations open to many objections, the principal one being the pollution of the water by dirt finding its way through defective floors and ill-fitting hatches on to the tank top, or to the interior through the dipping-hole. This applies particularly to a large number of fishing vessels on the coast, and the water is often rendered brackish by sea-water entering by the scuttle-hatch in bad weather.

Passenger vessels are, as a rule, well supplied with good storage tanks, easy of access, and usually situated in lower holds abutting on to engine-room bulkheads, places where an even temperature does not as a rule obtain, still, with a gravitation tank on the lower bridge, supplied with water from the others by a steam pump in the engine-room, the water becomes in a measure cooled and aerated, thus perhaps removing any objection on this account. These vessels, again, are supplied with good condensers or distilling apparatus.

The position of tanks in cargo steamers, particularly in the smaller ones, is almost invariable. In the larger deep-sea "tramp" they are usually found in the lower hold on each side of the tunnel-way, abutting on to the engine-room bulkhead, and are, as a rule, accessible either from the deck at all times, or by a manhole in the

engine-room bulkhead from the engine-room. Numbers of these vessels are supplied with good condensers, but, unfortunately, many are not, and, as a consequence, doubtful water is very often taken in owing to this omission.

With the smaller cargo steamers, which include vessels trading to the Mediterranean and the Baltic, the situations of tanks often leaves very much to be desired. Instead of being on deck (where they could often with safety be carried without affecting the question of stability) they are found in places not always accessible for cleansing and repairs. Cases have been known when the fresh water pump has broken down at sea, thus cutting off the supply, and only after the vessel's arrival in port, when the cargo was clear of the tank top, that it has become possible to remedy this.

The periodical cleansing of the tanks is of the utmost importance. Tanks situated below deck should be accessible at all times, the trunk-way leading thereto and the tank top not cramped for space, as is commonly the case.

After cleansing operations, a coating first of cement wash and then of limewash has been found to be most efficacious in preserving the inner surface of tanks.

Manholes should never be left uncovered, as vermin in quest of water frequently fall in and pollute the water.

Water ballast-tanks are frequently used for the storage of drinking water. This is a custom which should be discontinued, as dangerous to health.

CHAPTER X.

INQUIRY INTO THE DEATHS OF SEAMEN AT SEA.*

In course of a discussion at the International Congress of Hygiene, held in London in August, 1891, on the "*Statistics of Medical Cases admitted into the Seamen's Hospital, Greenwich, during the decade of* 1880-89, *and of Cases of Scurvy admitted into the Seamen's Hospital and into the 'Dreadnought,' from* 1852 *to* 1889," by John Curnow, M.D., and W. Johnson Smith, F.R.C.S. Miss Helen Taylor said: "I wish to suggest the necessity of the appointment of a medical officer (a coroner), at every port, whose duty it shall be to inquire into the cause of the death of every seaman who has died in the course of the voyage on board each ship which comes into port. It is plain that the most effectual way to secure healthy conditions on shipboard is to make the shipowner responsible for the injurious consequences of their absence. If a coroner found from the evidence of the fellow seamen that no complaints were made as to these, the matter would drop, but when there was evidence as to unwholesome food, undermanning, exposing each man to overwork to an extent injurious or fatal to health, or to any other sanitary arrangements, then the verdict of the coroner's jury would bring home to the shipowner his responsibility or otherwise for the death of the men on board his ship. This in all probability would quicken his movements towards securing obedience, not only to specific regulations imposed by law, but also the conditions recommended by medical and sanitary experience."

**Marine Register Book.*—In accordance with the Births and Deaths Registration Act of 1874, commanding officers of ships trading to or from British ports are required, under penalty, to transmit returns of all births and deaths occurring on board their ships to the Registrar-General of Shipping and Seamen, who furnishes certified copies of such returns to the Registrars-General of England, Scotland, and Ireland. Similar returns are furnished by persons having charge of Her Majesty's Ships directly to the Registrars-General of Births and Deaths. These returns of births and deaths at sea constitute the "Marine Register Book." So far as can be judged by the entries, which are not always precise, the births in the year 1894 included 17, and the deaths 1,080, persons of English origin, while 13 and 198 others respectively were indefinitely described as of "British" origin.—*Fifty-seventh Annual Report of the Registrar-General of Births, Deaths, and Marriages, 1894.*

The Births and Deaths Registration Act has been the foundation of great sanitary reform to this country. And the statistics to which it has given rise have been to reformers the basis, as it were, of their observations, as showing up the weak spots in the death rate, and on the other hand recording practical results.

The beneficial outcome of this humane Act is evidenced by the reduction of crime in all its phases,; deaths by violence, sudden deaths (unknown causes), premature deaths, etcetera.

In a letter addressed to the coroners in 1845, Mr. George Graham, the then Registrar General, states: "It is to discover the dangers attendant on the occupation, pursuits, and various circumstances in which the population is placed that I request your aid, in the hope that if the causes of death are ascertained, additional security may be thrown around human life, and thus the great object of a coroner's inquest be promoted by the Registration Act in improving the public health, preventing crime, and advancing medical science, *The inquiry into the causes of violent deaths* must be complete, and must include three classes of particulars."

(1) *The first class of facts comprised under the cause of death has reference to persons.* It is the legal point of view.

(2) The second class of facts has reference to things: to the instruments employed where human agency is concerned, in other cases to animals, machines, and ordinary mechanical force, or bodies of nature. With reference to the *public health* it is the most important head of the inquiry.

(3) Physical injuries, causing death, constitute the third class of facts. It is *the medical point of view.*

Again on the causes of violent death he states:

XII. "The Registration Act has made it imperative in England to investigate on record the causes of every person's death. The object of the inquiry is, that the precise nature of these causes may be determined; that they may be carefully analysed, and that means may hence be devised for guarding against their effects, and for throwing additional security around human life."

Much credit is due to Mr. Graham for this able exposition and guidance at a time when reform in these matters was a crying evil. Such wise counsel given to those in authority could not but have a salutary effect in promoting the principles of the Registration Act, and fortunately at the present time, the doctrines of the Act so clearly set forth, are at work in all branches of society.

The great shipping industry, however, has to a very great extent been outside the pale of its influence. To study the return of deaths as issued monthly by the Registrar General of Shipping and Seamen, is to lay hold of some very hard facts in connection with life at sea. For instance, on the first page of the returns of August, 1897, will be found recorded, the death of a coal trimmer as "*Missing, supposed fallen overboard or suicide.*" On the next page is recorded the death of an able seaman, the cause being, "*Fell off the jibboom, owing to the breaking of the footrope, and drowned.*" Page 3, a fireman "*Disappeared during his watch on board.*" And on the next page the death of another fireman is entered as "*Supposed suicide.*" The following month (September) is no less interesting. On page 3, the death of a fireman is given as "*Drowning. Fell overboard emptying his ashes and was drowned.*" Page 5, gives a mess-room steward, "*Disappeared,*" and a lascar fireman "*Was found missing, and is supposed to have jumped overboard.*" On the next page a donkeyman's death is recorded as "*Missing.*" Page 8, a 2nd engineer "*Fell overboard and was drowned at sea,*" and a trimmer, "*While trimming coal fell from main deck into lower bunker, striking coaming of 'tween deck hatch in descent.*" The deaths of eight apprentices are also recorded for this month as follows: two "*drowned,*" one "*enteric fever,*" one "*inflammation of the lungs,*" one "*fever,*" one "*falling from aloft,*" one "*killed by falling down hatchway,*" and one, "*jumping overboard in trying to save himself after the vessel foundered.*" These few cases have been quoted from 453 deaths recorded in the two months mentioned, and are merely cited to show how the cause of death is returned, the cause of death given being in most cases an abstract report taken from the official log. They will, however, be sufficient for the purpose as showing how unsatisfactory and meagre, the information is for particular cases. It is obvious, that something of a more practical nature, than the following method of inquiring into the deaths of seamen at sea, is absolutely necessary.

To give in outline the method of inquiry, it will be necessary to begin from the time the master "signs his crew on" at the shipping office, or on board his vessel in dock.

Among the many duties of a shipmaster, the care of his crew is by no means the least important. He is held responsible under pain of penalty for giving a true account of all the members of the crew on the ship's articles. The Board of Trade provides him, at a nominal fee, with an official log-book (O. 1), wherein all breaches of discipline, &c., must be entered. The value of that book as a record is foreshadowed in the directions given to ship-masters with reference thereto, and which states: "The importance of keeping this book properly, and duly making all entries at the proper time, with the strictest regard to form, cannot be too strongly impressed on ship-masters.

If illness, injury, or death occurs at sea, or on board ship in harbour, an entry has to be made in this log-book; which entry the Merchant Shipping Act, 1894, sub-sec. 5 of sec. 239 states: "shall be signed by the master, and by the mate or some other of the crew."

Upon the first arrival of the vessel at any port other than that of the termination of the voyage or agreement (when the official log-book must be delivered up for transmission to the Registrar-General of Shipping and Seamen), the master must report and deliver, on a printed form provided for him, a true copy of the particulars of the death so recorded in the official log-book to H.M. Consul, Superintendent of Mercantile Marine, Collector of Customs, or other officer for transmission to the Registrar-General of Shipping and Seamen.

H.M. Consul or other officer, on receipt of this form, will hold an investigation, and shall interrogate the master and other members of the crew as he thinks necessary, from another form, that is if the case is other than suicide or "missing" of firemen and trimmers; and, if the latter, from a different form, headed "Inquiry into causes of death of a Greaser, Fireman, or Trimmer, who is reported to have committed suicide or as 'missing.'"

The officer may, according to the forms, ask additional questions as the circumstances of the case warrant, and, if any member of the crew makes a written statement relating to the case, such statement is to be attached to the form of inquiry; the custom being not to take evidence on oath.

If, in the officer's opinion, the evidence is satisfactory, or, on the other hand, unsatisfactory, the following printed form at the back of form B and D 3 is signed by him. The form reads as follows:—

"The foregoing information has been obtained by me in my inquiry into the death, and I have examined ( ) members of the crew, and consider that further inquiry is (necessary or unnecessary)."

Signature of Officer.
Title of Officer.

On the vessel's arrival at a home port the Superintendent of the Mercantile Marine Office is authorised by the Board of Trade to make a supplementary inquiry *as he deems fit.*

As regards illnesses and injuries (accidents) recorded in the official log-book, beyond the number of fatal and non-fatal accidents which are published monthly in the "Labour Gazette," and the statement in the abstracts in shipping casualties giving the number of fatal accidents by

(i.) Wreck and casualty,
(ii.) Other accidents,
(iii.) Homicide, suicide and disease,

there are no official returns from which may be ascertained the various numbers of classes and causes of fatal accidents; and beyond the few details given in the "Labour Gazette," there is no information referring to non-fatal injuries and illnesses.

The introduction of printed forms of inquiry by the Board of Trade, for general use, dates only a few years back, and since the appointment of Mr. J. Clark Hall, as Registrar-General of Shipping and Seamen. These forms have from time to time been materially improved upon, and at the present moment are certainly up to date. But, unfortunately, a very weak link in connection with these paper inquiries, is that technical knowledge and medical experience are really required in conducting the inquiry in order to arrive at the real facts of the case. Are the officers who carry out these very important duties qualified to investigate matters, which really come within the domain of medical and nautical experts? As is well known our Consular officers are noted for their intelligence in commercial matters, but it is open to question whether they, in general, possess sufficient technical knowledge of a vessel to act as sole arbiter in these cases. A great number of these officers are merchants, probably interested in the ship and cargo, in such a case they could not be termed disinterested parties. The laxity sometimes displayed respecting these inquiries is a positive scandal. As a matter of fact, the forms are often indifferently filled in, and sometimes even handed to the masters to fill in themseves. There is, however, a bright side to this picture, because there are a great number of the British Consuls, who are deserving of much praise, for the time and trouble, they take in making the seamens's lot in foreign ports a better one than formerly.

The officers at a home port, who are often delegated by the Superintendent of the Mercantile Marine Office to make the inquiry, are known as shipping masters, but are really the Superintendent's deputies. Men of wide experience they must be, gifted with much tact and patience, otherwise they would be unable to carry out their intricate duties as they do. These duties are further complicated by having frequently to deal with men who are proverbial for their ignorance of details and economy; hence it is obvious that the position of these officers is no sinecure.

As these officers are under the immediate control of the Local Marine Board, it will be well to show what constitutes a Local Marine Board, and the Board of Trade's power over the same.

The seventh schedule to the Merchant Shipping Act, 1894, states:—

"(a) The mayor and one stipendiary magistrate.

"(b) Four members appointed by the Board of Trade from

among persons residing or having places of business at the port, or within seven miles thereof.

"(c) Six members elected by the owners of such foreign-going ships or home-trade passenger ships as are registered at the port."

Sub-sec. 2 of sec. 246, Merchant Shipping Act, 1894, states:

"In every port where there is a Local Marine Board, the Board shall procure the said buildings and property, and appoint and remove the superintendents, deputies, clerks, and servants, and regulate the business at, and have the control of, the Mercantile Marine Office, subject as follows:

"(a) The sanction of the Board of Trade shall be necessary, so far as regards the number of persons to be so appointed, and the amount of their salaries and wages, and all other expenses.

"(b) The Board of Trade shall have the immediate control of every such office, as far as regards the receipt and payment of money thereat; and every person appointed to be an officer in such office shall, before entering upon his duties, give such security (if any) for the due performance thereof as the Board of Trade requires."

Thus it will be seen that these officers are, in effect, the *employés* of the Local Marine Board, and the Board of Trade does not specify that they should have special qualifications for their varied duties.

With all due regard to H.M. Consuls and other officers who make inquiries, some more searching and practical method is required for particular cases, For instance, take the case of "suicide," or supposed suicide or "missing." Among firemen and trimmers reported on by the Registrar General of Shipping and Seamen in a memorandum issued last year, an abstract of which was published in the Board of Trade Journal for April, 1896, under the heading "*Suicides in the Engine-room Staff of the Mercantile Marine*," page 395 states:

"An analysis of the reports of inquiries of the officers shows that 30 firemen and trimmers serving under ordinary agreement, and 19 Asiatic firemen and trimmers serving on a vessel trading to the United Kingdom under Asiatic agreement committed suicide, or are supposed to have committed suicide, in 1894, as against 27 and 14. respectively in 1893.

"The Registrar General calculates that the rate of suicide amongst firemen and trimmers in the Mercantile Marine is about 1 *in* 900 Suicide amongst stokers in the Royal Navy is unknown.

"The rate of suicide amongst all males between the ages of 20 and 55 which practically covers the active life of seamen, appears from the reports of the Registrar General of Births and Deaths to be about 1 *in* 5,000.

"There can be little doubt, concludes the Registrar, that the figures as regards 'suicide' or supposed suicide, fairly represent the actual condition of things, and though the rates of suicide I have given, based as they are on estimates, may be criticised, no amount of criticism will obscure the fact, that suicide amongst firemen in our Mercantile Marine service, is prevalent to a degree calling for serious attention."

Investigations have recently been made by the Board of Trade surveyors into suicide and "missing" cases as they come in. In some instances remedies for reducing the heat in the stokehold have been carried out with beneficial results. This, however, does not altogether meet the case, as all the cases of "missing" cannot be traced to a hot stokehold or engine-room. For example, in the April and May returns for 1897, issued by the Registrar General of Shipping and Seamen, will be found respectively two 1st engineers returned as "*Missing; supposed to have accidentally fallen overboard and been drowned.*" Surely some more stringent inquiry is required for these cases. Such a state of things does not exist on shore, why should it afloat, where the opportunities for foul play are many, and the chances of detection remote?

A great number of cases of loss of life by shipping casualties are tried by a proper court of inquiry.* Could not the same measure apply to these particular cases, and on a vessel's arrival at a home port, before any of the crew are paid off and allowed to leave the vessel; in short, is not a man's life as important as that of a ship? By way of illustration, if a man was washed overboard and drowned, and there was no casualty to the ship, no inquiry can be held; but on the other hand, if a boat or spar was washed away by a sea at the time of the accident, an inquiry can be held. This explains the position with reference to inquiries into the Deaths of Seamen at Sea, and opens out a point in connection with powers convening these "paper" inquiries. The plain fact appears to be, they have been introduced by the Board of Trade as a philanthropic measure, but their legal position and value is not so apparent.

For Colonial ports, sec. 478, Merchant Shipping Act, provides that—

"The legislature of any British possession may authorise any court or tribunal to make inquiries as to shipwrecks, or other casualties affecting ships."

---

* Section 464, sub-sec. 4, Merchant Shipping Act, 1894.

Again, for foreign countries, sec. 480 of the same Act provides for "Naval Courts on the High Seas and Abroad," and states :—

"A court (in this Act called a Naval Court) may be summoned by any officer in command of any of Her Majesty's ships on any foreign station; or, in the absence of such an officer, by any Consular officer in the following cases :—

"(i.) Refers to complaints.

"(ii.) Whenever the interest of the owner of any British ship or of the cargo thereof appears to that officer to require it."

Is it not, therefore, to the interest of the owner, and fair to the relatives of the deceased, that a verdict be given by a proper official court of inquiry, at the first port of arrival after the occurrence, *and before any of the crew are discharged from the ship?*

These sections as they stand cannot, of course, meet the difficulty. They have merely been quoted to show why the respective Courts of Inquiry are held, and how, with very little amendment, they could be made to apply to the question at issue.

The interest taken in the great shipping industry, during the debates in the House of Commons on the Workmen's Compensation Bill, and the favourable comments in the daily press about the same time, is indicative of public feeling generally towards a class of men, who by the nature of their risky calling are fully entitled to the same protection as their comrades on shore. There is no doubt, but that if the measure had been made to apply to them, a better and more practical system than the one in vogue for inquiring into the deaths of seamen at sea, would as a consequence have ensued.

Sooner or later legislation on this point must come about, and the sooner the better, as it will undoubtedly be more satisfactory to all concerned.

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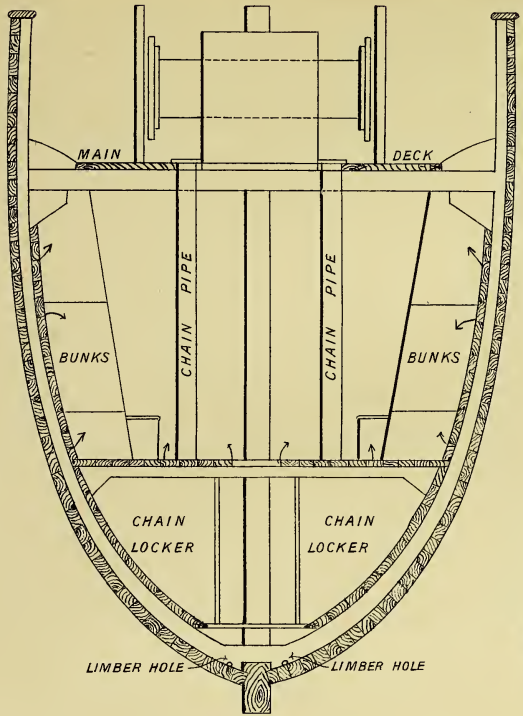


FIG. 2. TRANSVERSE SECTION AT A.B.
(LOOKING FORWARD).

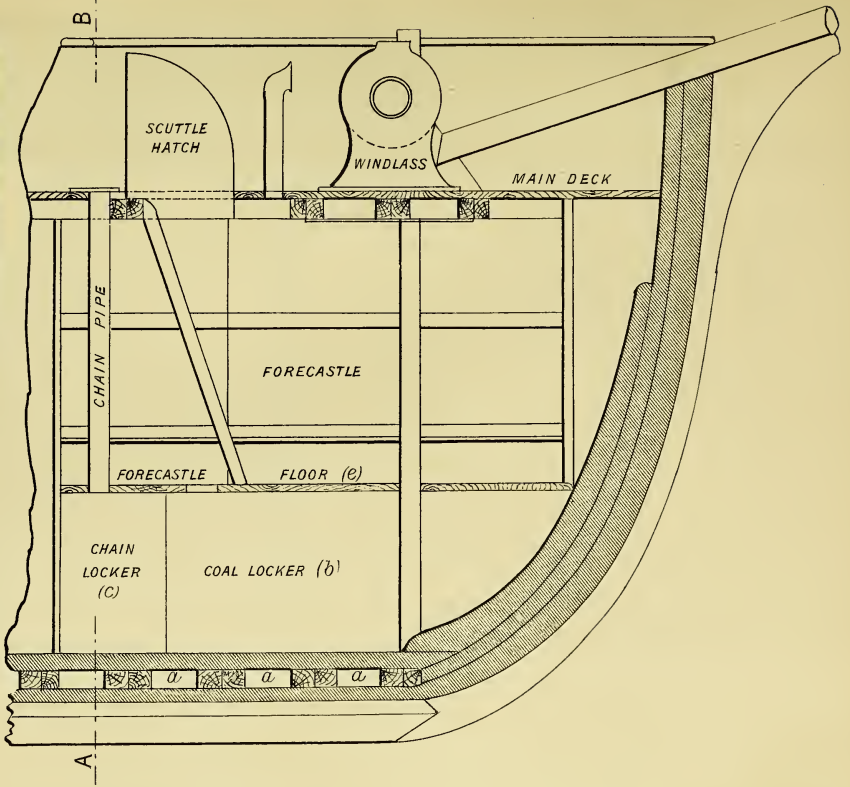


FIG. 1. SECTION THROUGH LOWER FORECASTLE.

FIG. 3. SEC

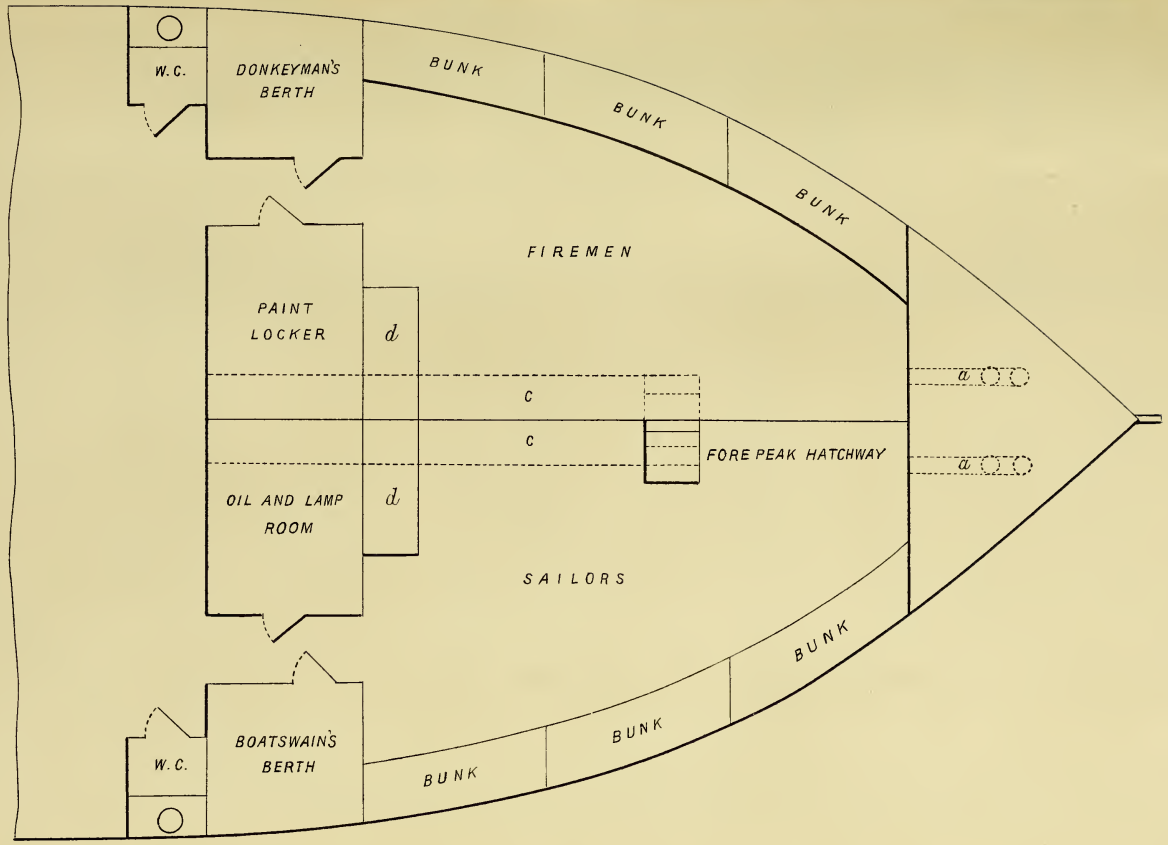


FIG. 4. PLAN OF TOPGALLANT FORECASTLE.

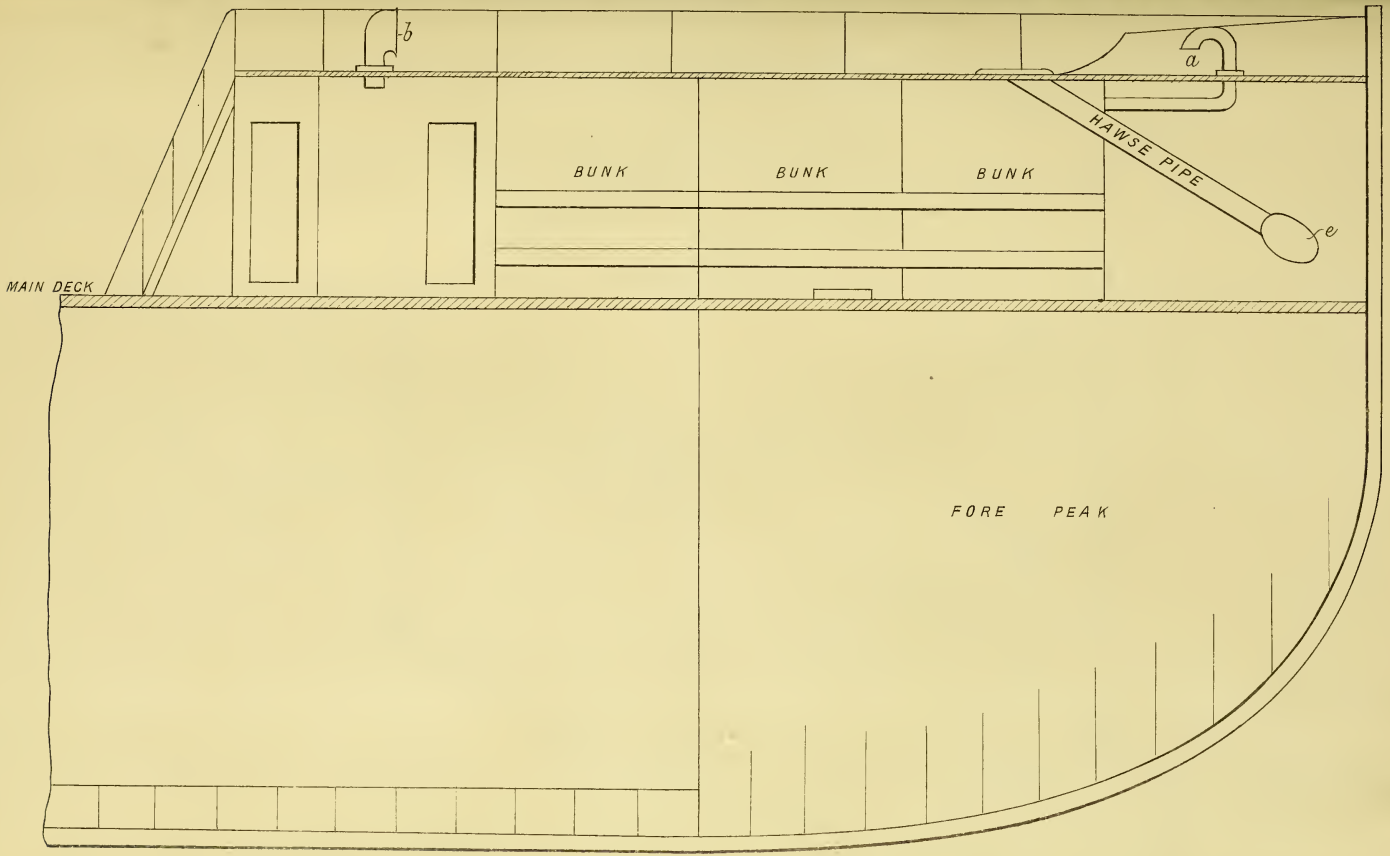


FIG 4ª SECTION THROUGH TOPGALLANT FORECASTLE.

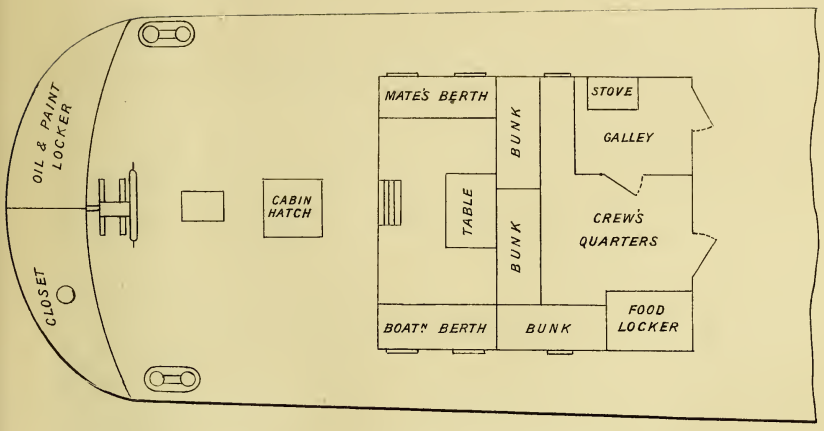
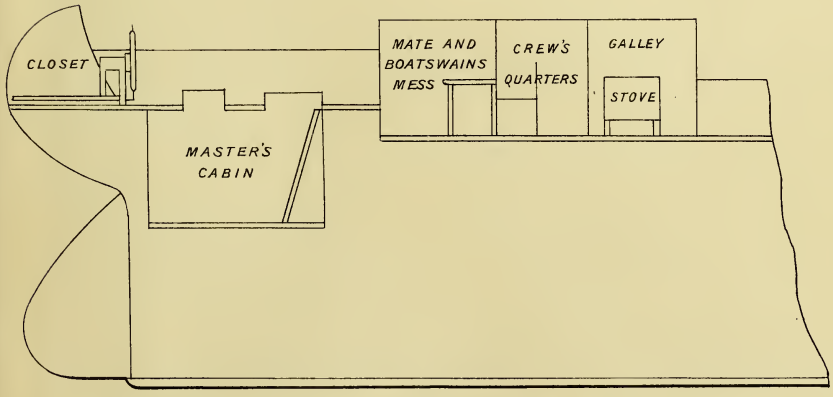


FIG. 5. PLAN OF DECK HOUSE ON A GERMAN SCHOONER.



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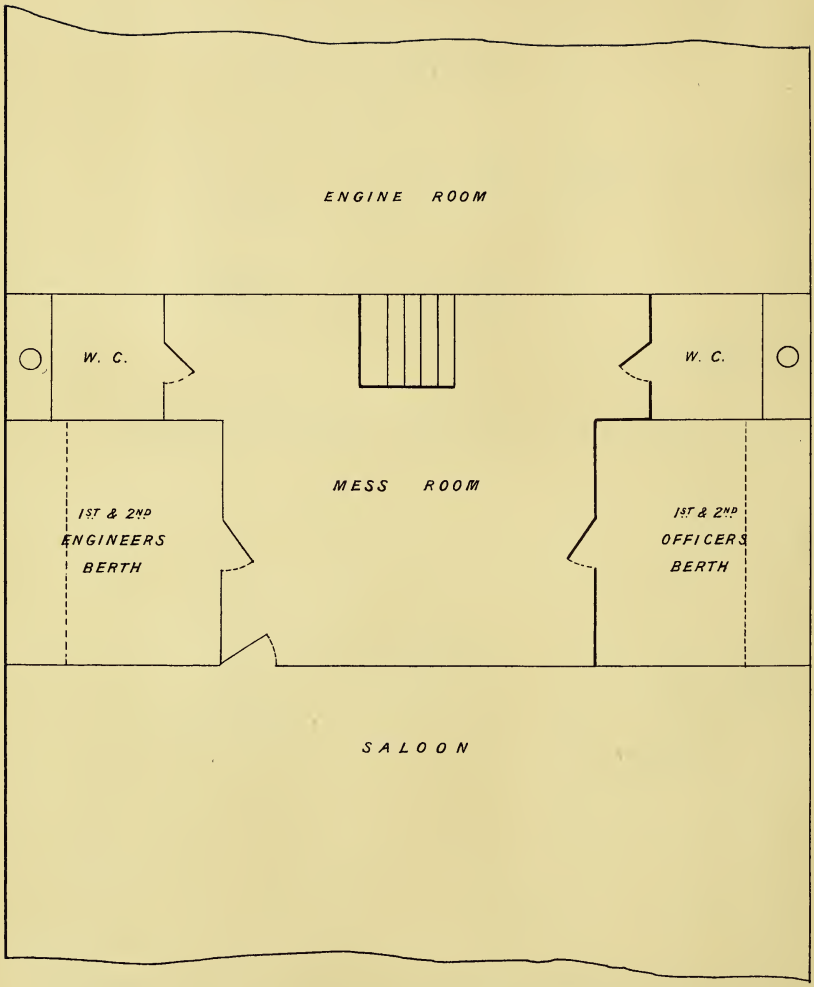

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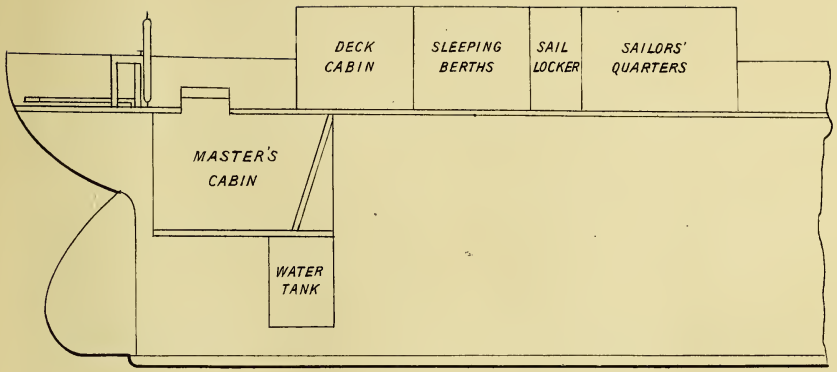

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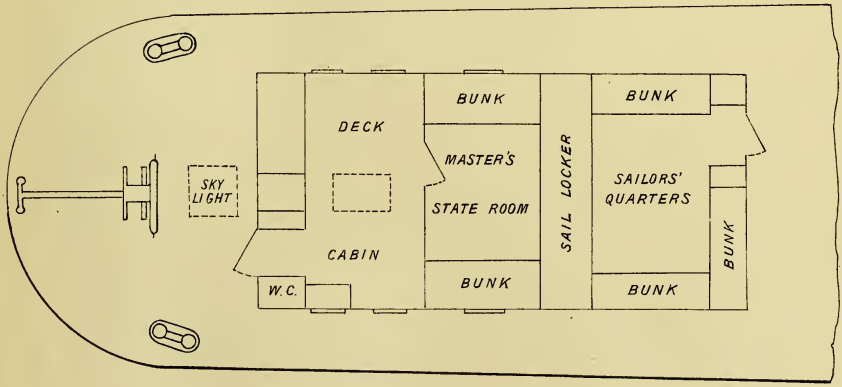


FIG 8. PLAN OF DECK-HOUSE ON A DUTCH BARGE

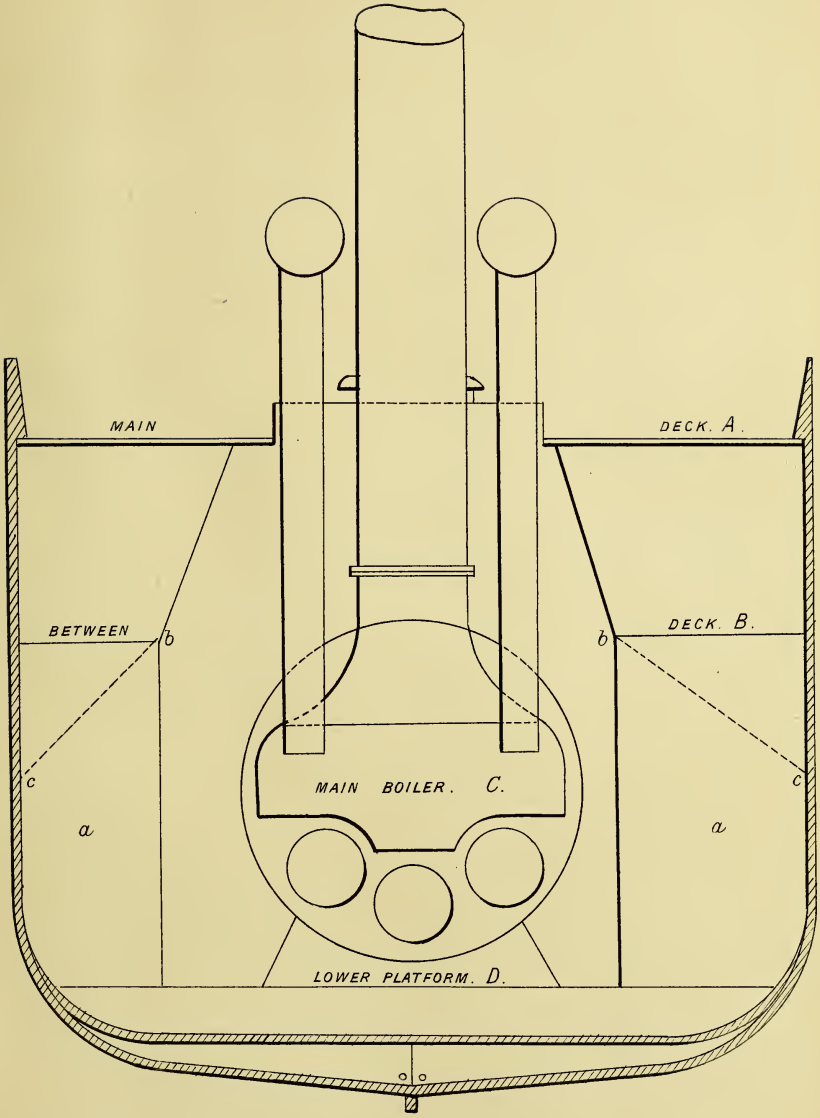
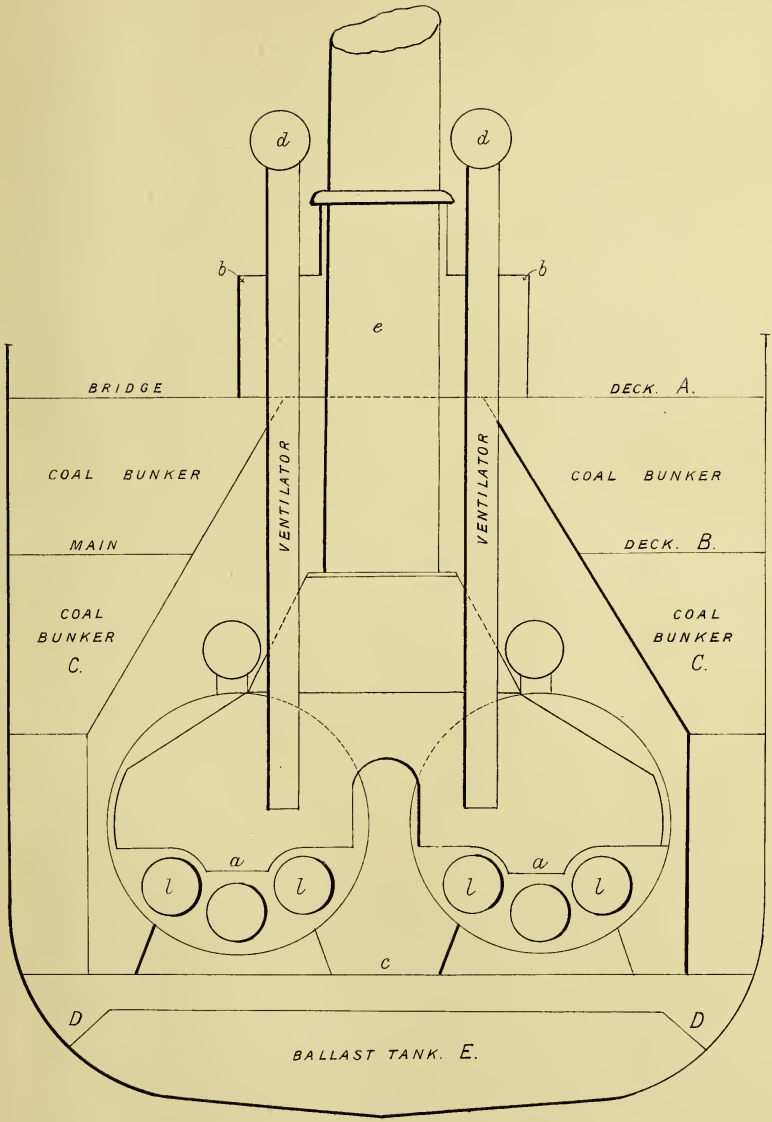


FIG. 9. TRANSVERSE SECTION OF STOKEHOLD.
(LOOKING AFT).



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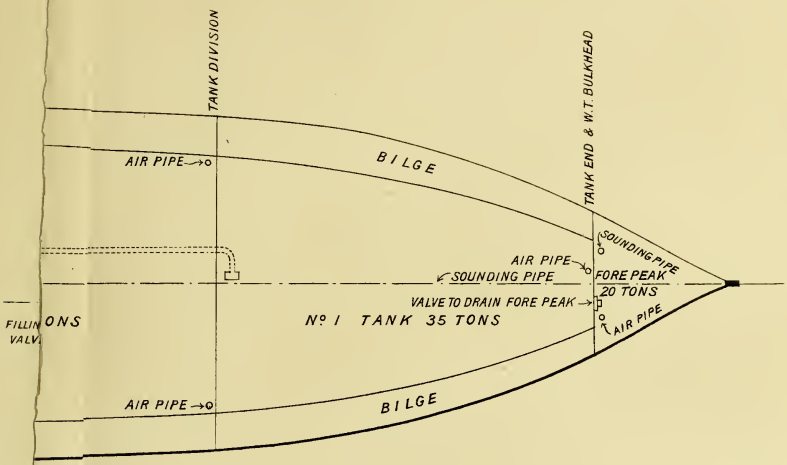
(LOOKING AFT).


TANK DIVISION
TANK END & W.T. BULKHEAD
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BILGE
SOUNDING PIPE
AIR PIPE
SOUNDING PIPE
FORE PEAK
20 TONS
VALVE TO DRAIN FORE PEAK
AIR PIPE
No 1 TANK 35 TONS
AIR PIPE
BILGE

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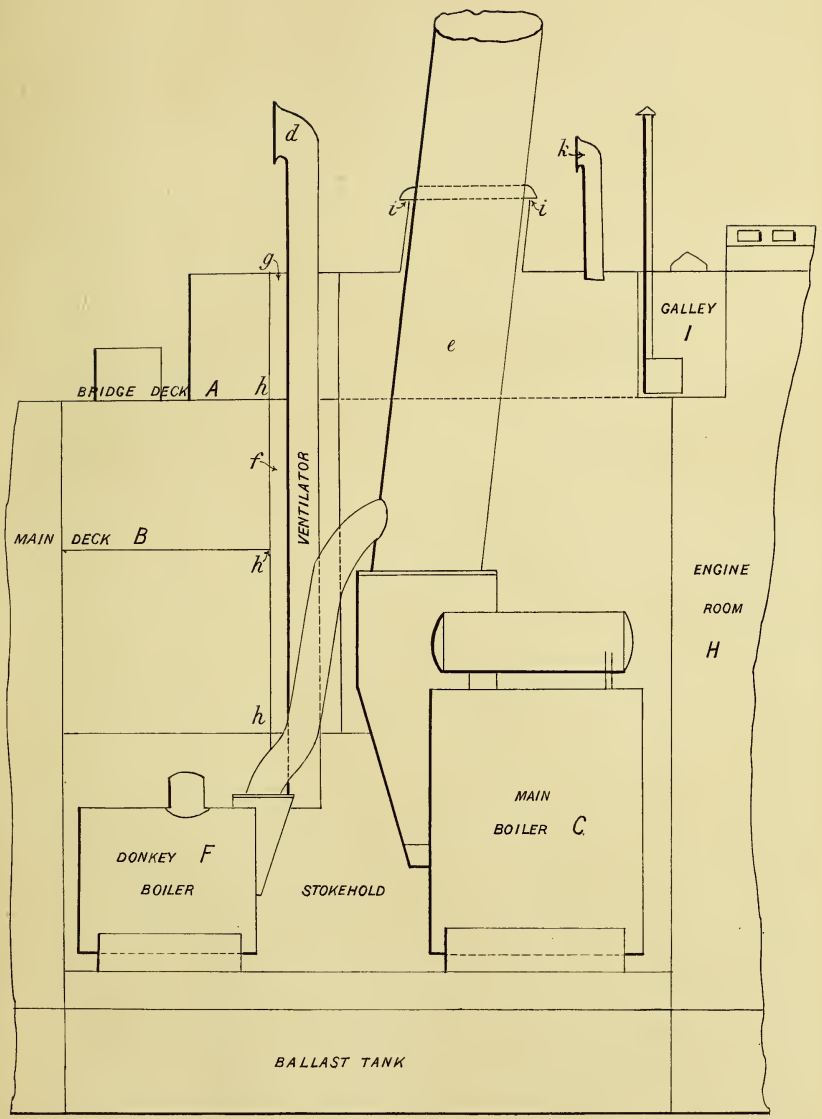
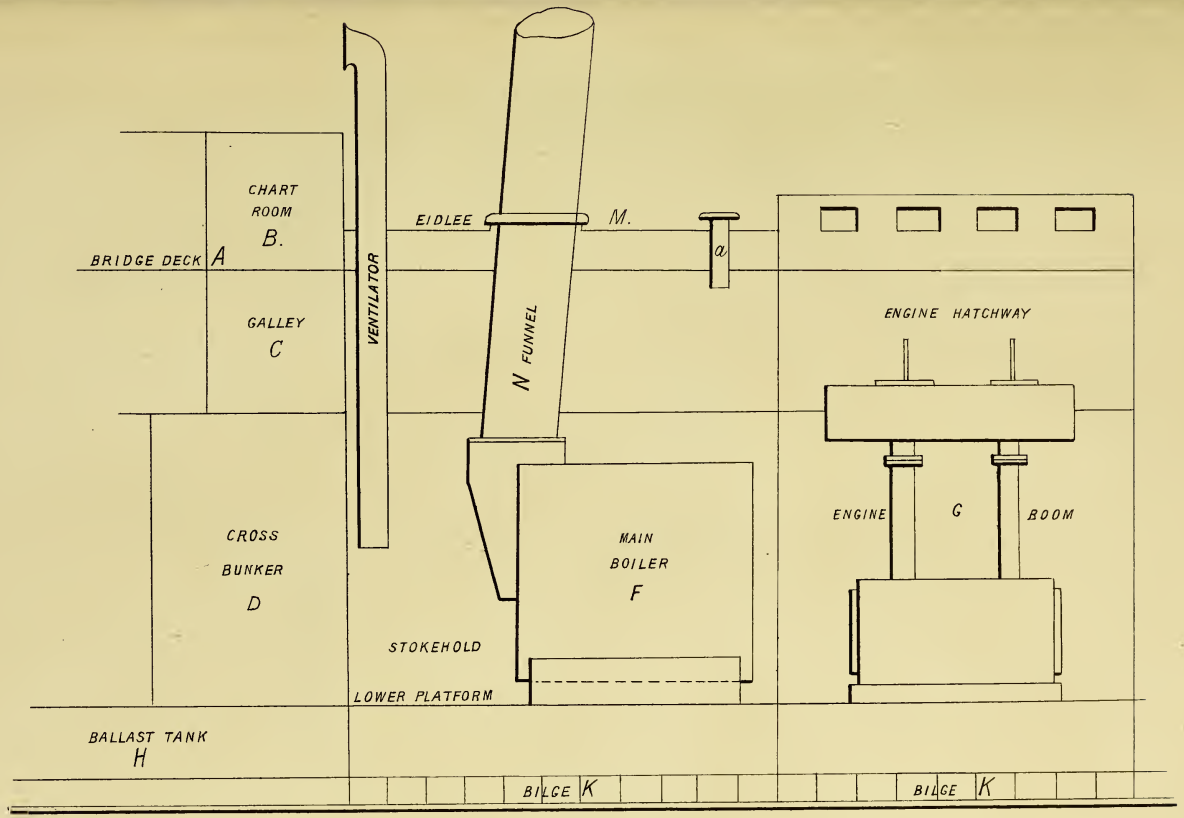


FIG.12. SECTION OF STOKEHOLD, _ FORE AND AFT



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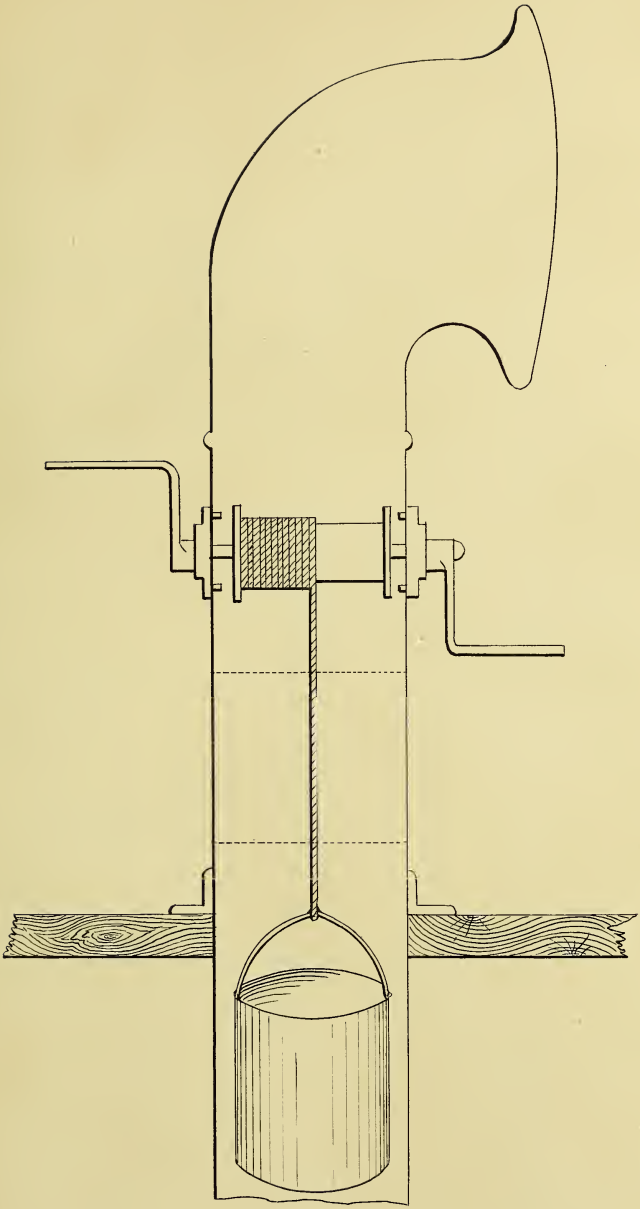

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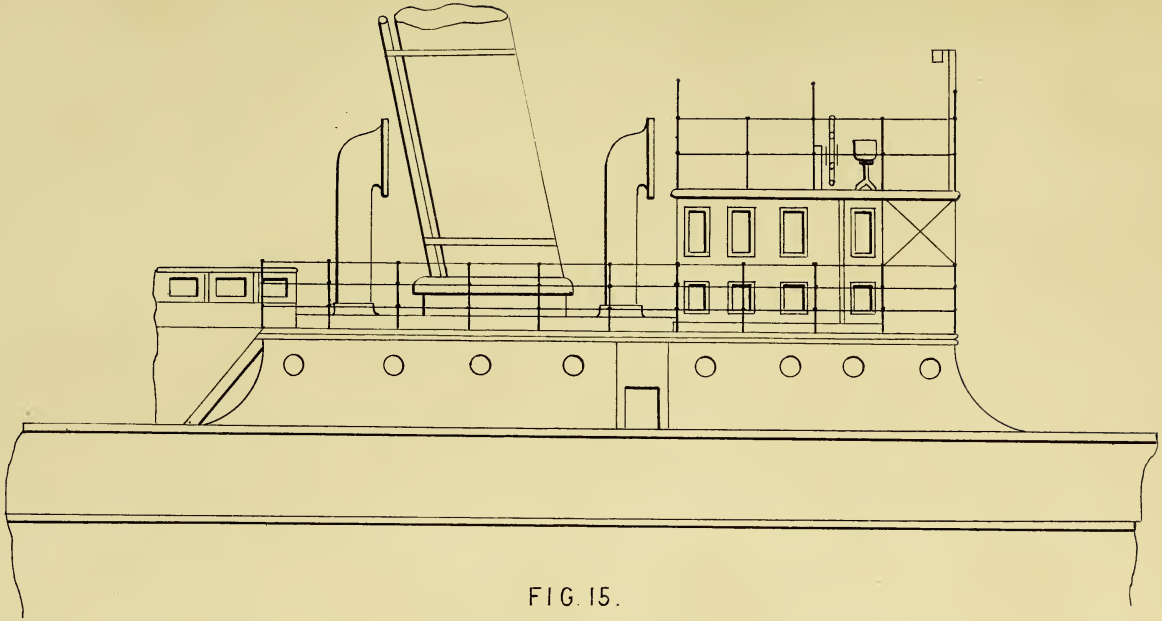

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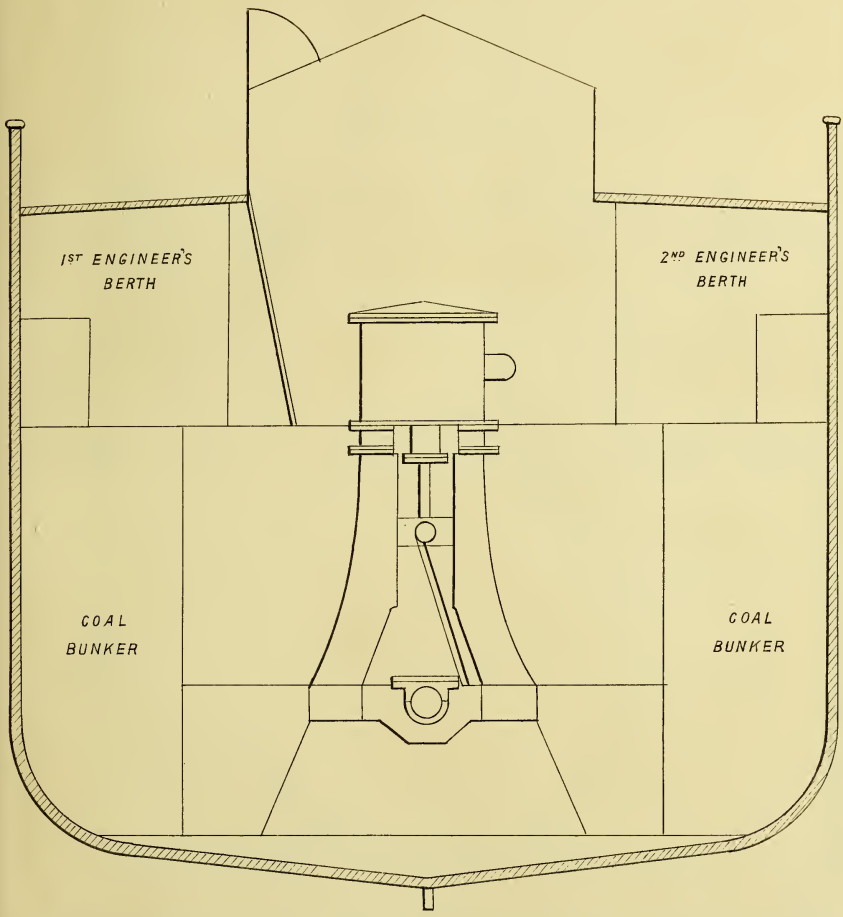

FIG 1. SECTION AT ENGINE ROOM SHEWING BERTHS AT SIDES OF CYLINDERS
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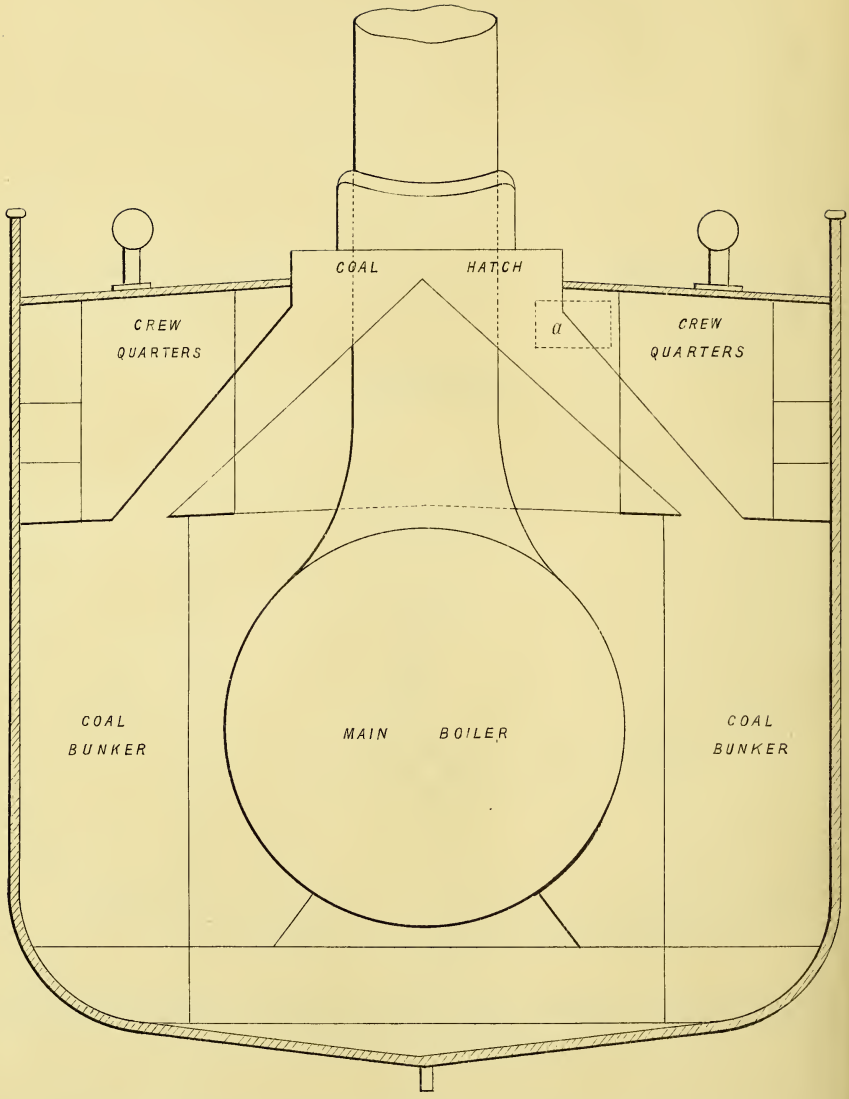

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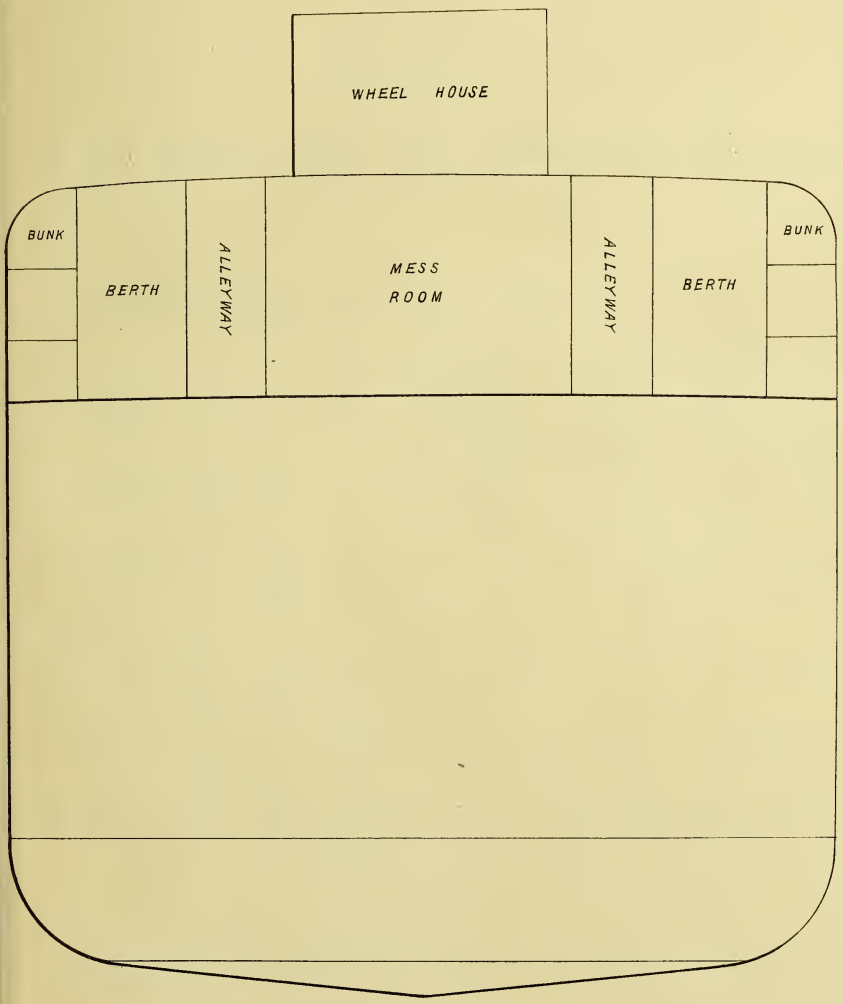

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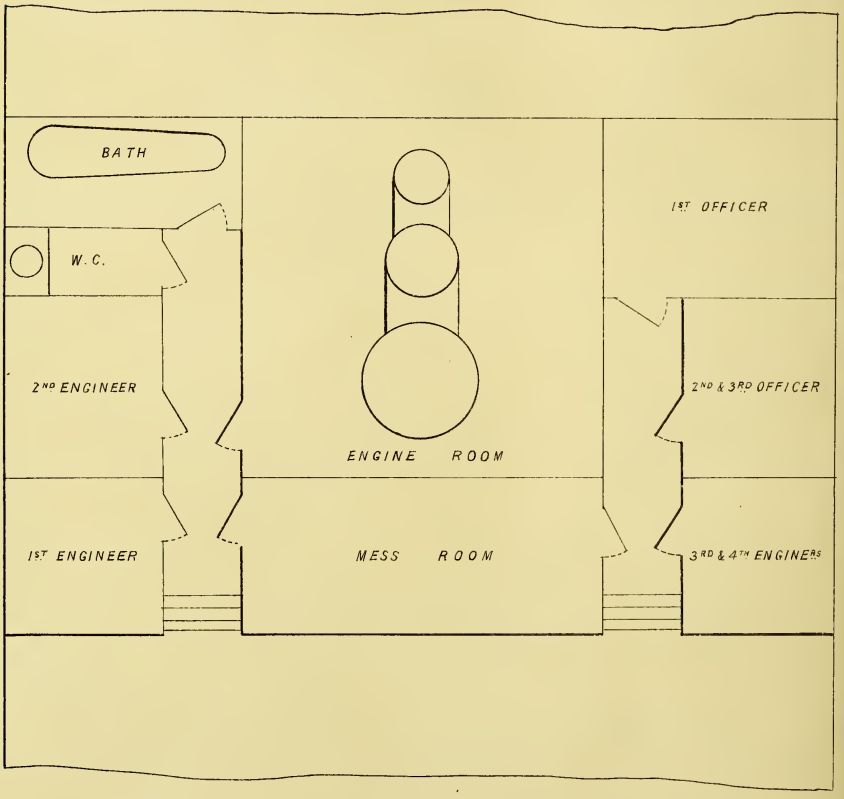


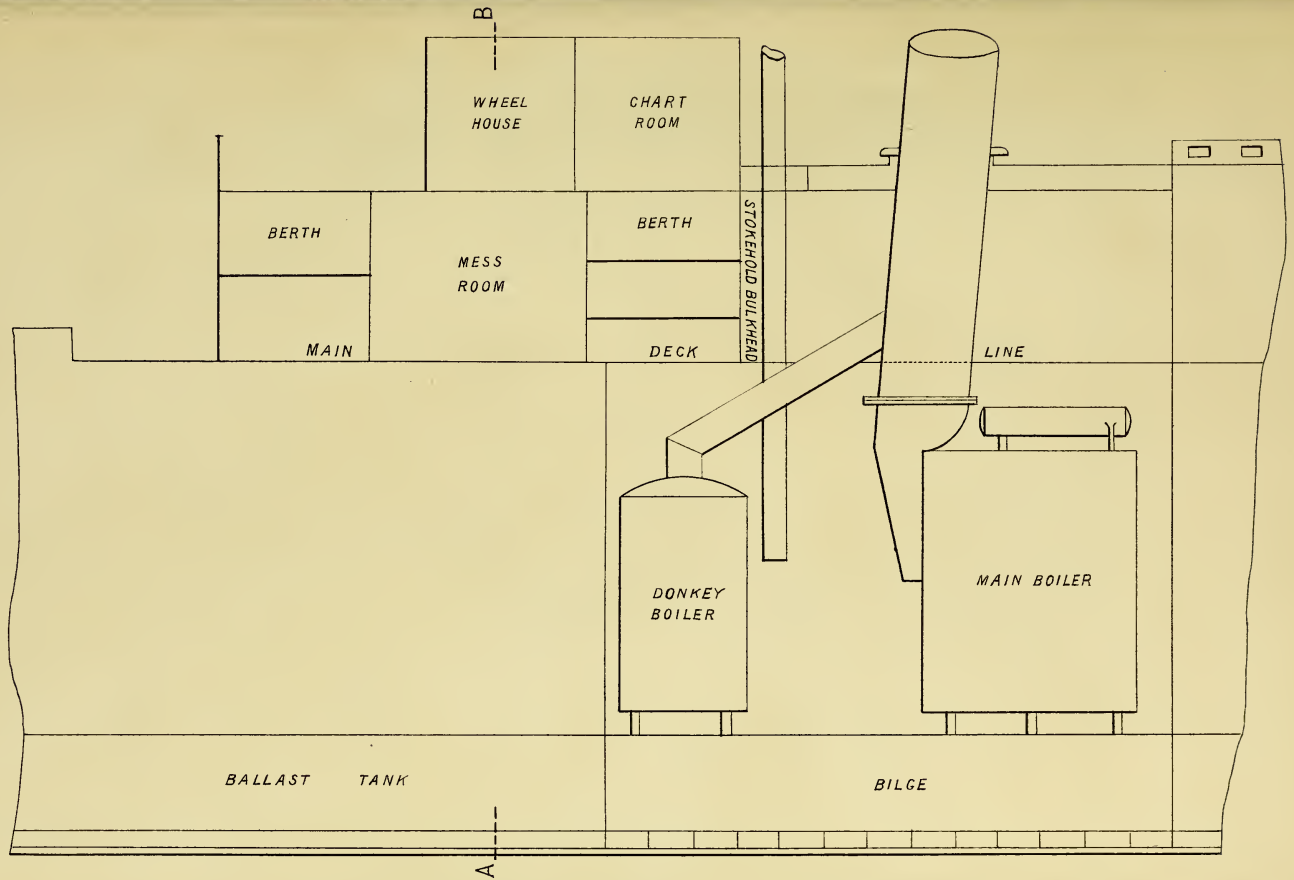


FIG.20. SECTION SHEWING BERTHS OVER DONKEY BOILER

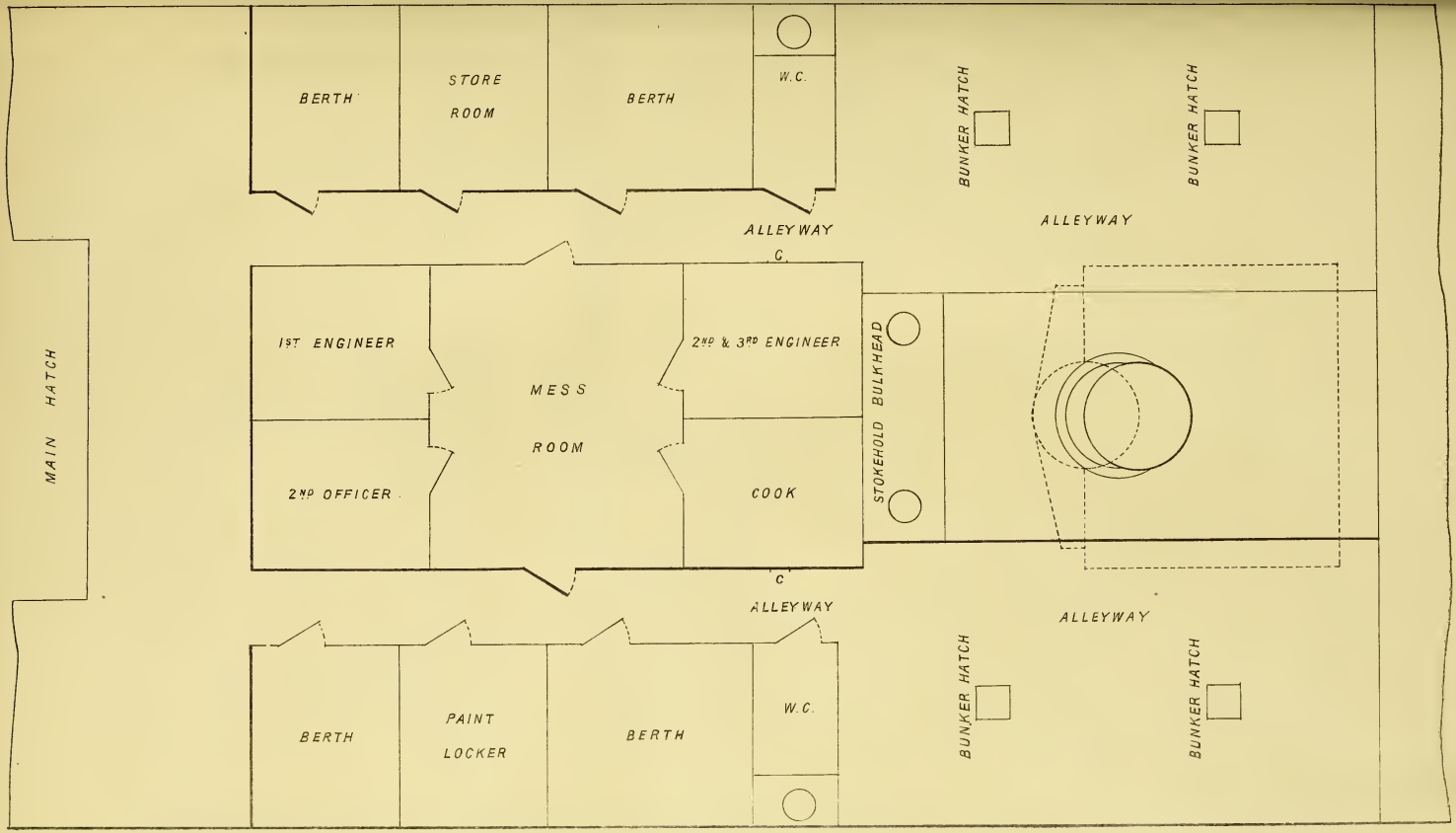
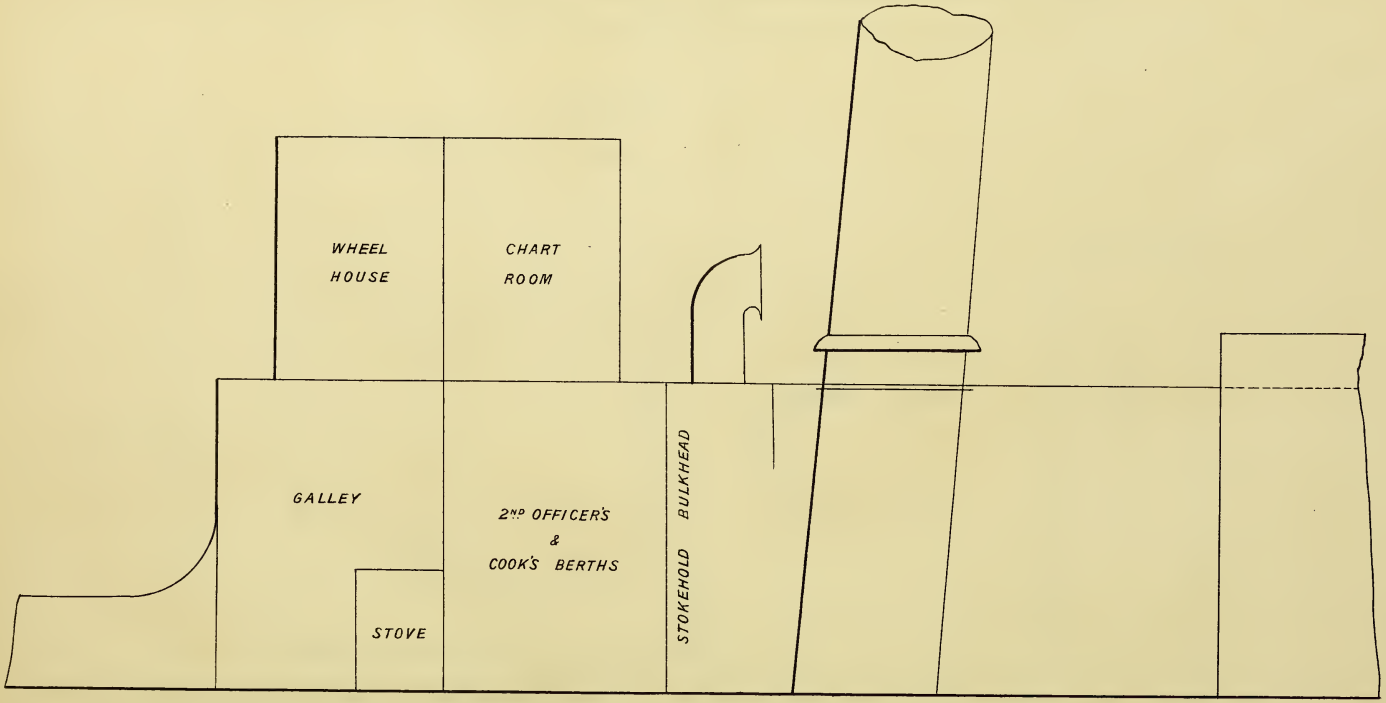


FIG 19. PLAN OF BERTHS ON MAIN DECKS.



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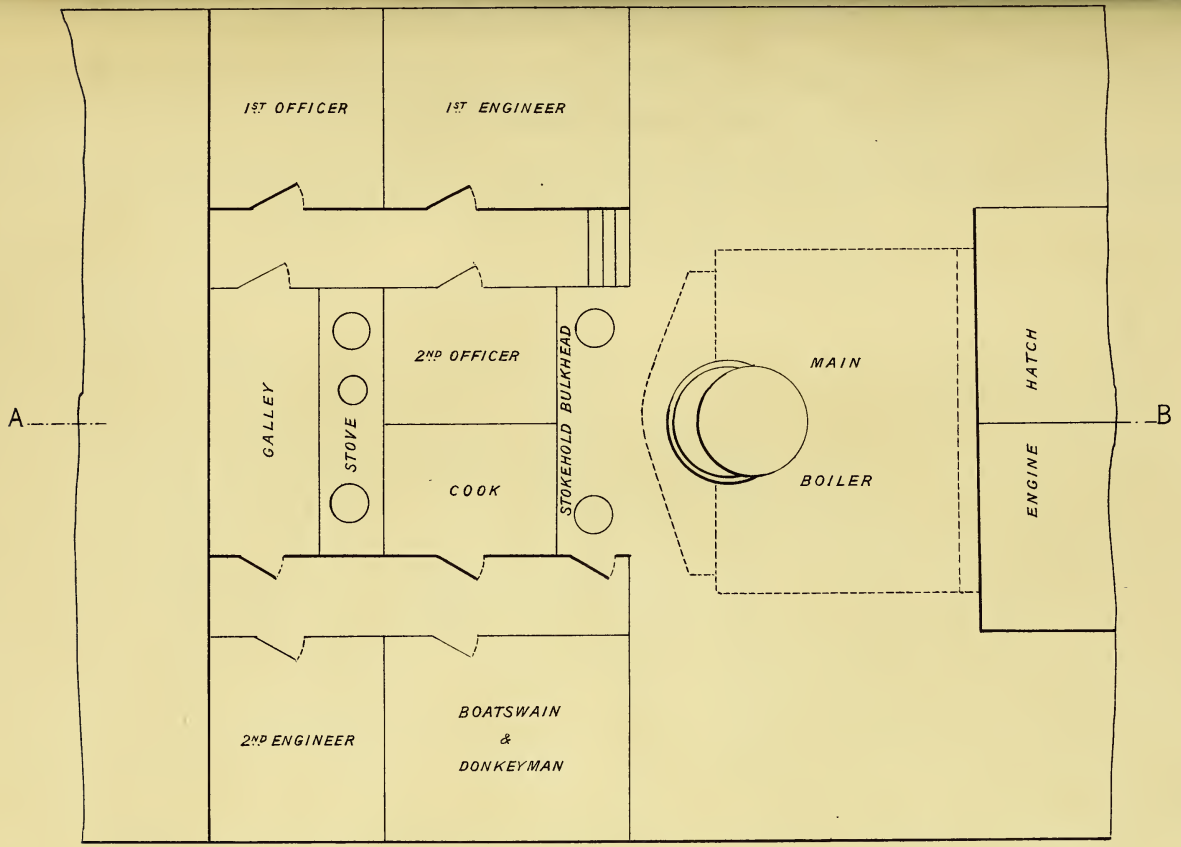

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